Program and Abstract Book

Minnesota Water Resources Conference

October 18–19, 2016
Saint Paul RiverCentre

wrc.umn.edu/waterconf

Minnesota Water Resources Conference

October 18–19, 2016

Guidebook Mobile App

The Minnesota Water Resources Conference has gone mobile! Attendees can plan their days with a personalized schedule and browse keynote speakers, concurrent sessions, and venue maps. The app is compatible with iPhones, iPads, and Android devices. Windows Phone and Blackberry users can access the same information via the mobile site: http://guidebook.com/guide/67019

iOS and Android users:

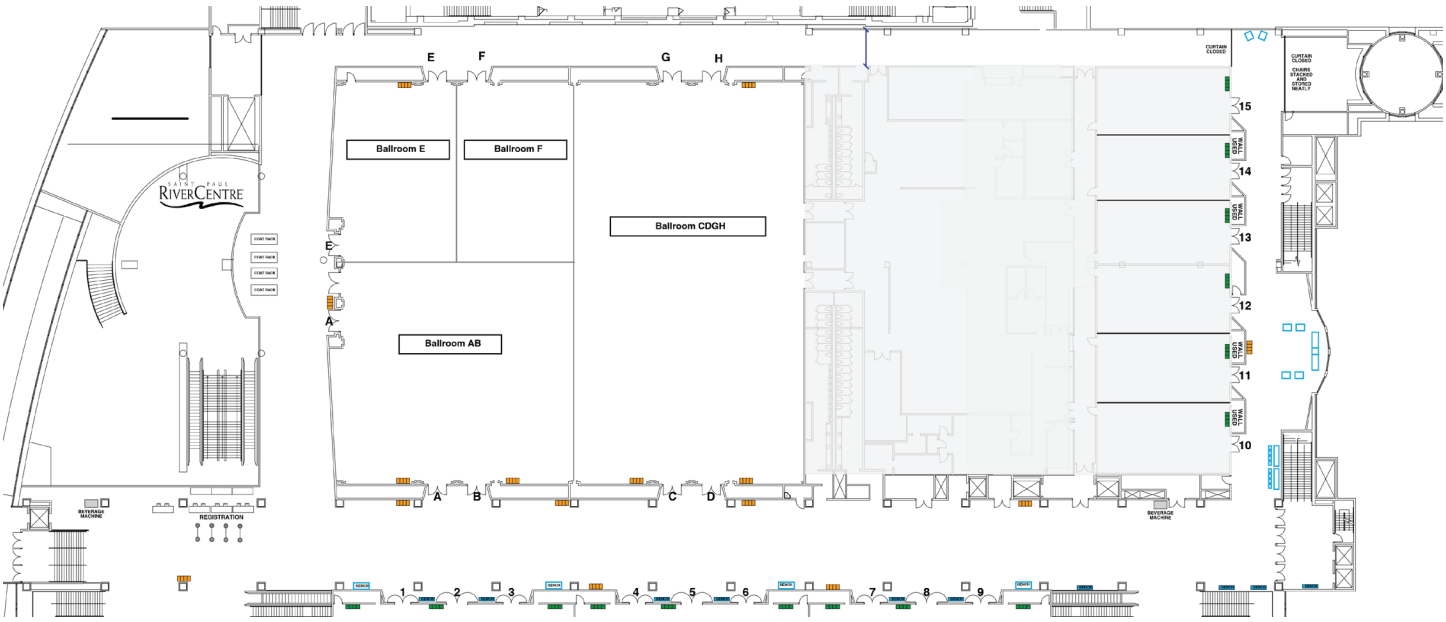
- Download 'Guidebook' from the Apple App Store or the Android Marketplace
- Scan the following image with your mobile phone's QR-Code reader

Social Media: Join the Conversation

We invite you to join the conversation about the Minnesota Water Resources Conference by tweeting about the symposium, or posting updates to your LinkedIn and Facebook pages. The conference hashtag is #mnwrc15. Type this hashtag in your tweet posts to continue the conference "backchannel," or you may also search Twitter for this hashtag to view the tweets online. These social media efforts will help participants network and meet new colleagues prior to and during the conference.

Continuing Education Units (CEUs); Professional Development Hours (PDHs)

Conference attendees will receive .675 CEUs and 6.75 PDHs for each day of the Minnesota Water Resources Conference. Participants who wish to receive full credit must attend all scheduled hours of the event.



Sponsored by:
Water Resources Center
University of Minnesota
Driven to Discover℠
College of Continuing Education
University of Minnesota

Cosponsored by:
Department of Civil Engineering, University of Minnesota
Minnesota Section, American Society of Civil Engineers
Minnesota Sea Grant College Program, University of Minnesota
Natural Resources Research Institute, University of Minnesota

Minnesota Water Resources Conference

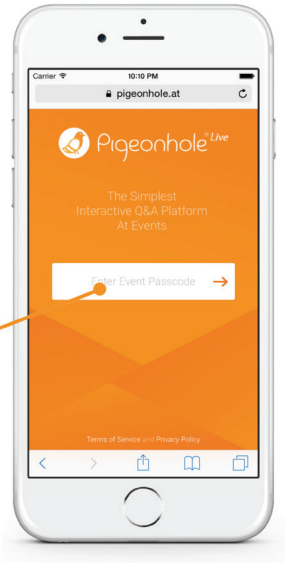
October 18–19, 2016

This conference uses Pigeonhole Live for Q&A.

Pigeonhole Live is a simple, interactive mobile website where you can submit questions to speakers via your mobile web device. You can also vote on questions that interest you. Here's how you can participate!

Go to **www.pigeonhole.at**.
Enter event passcode:

MNWRC16



2016 Water Resources Planning Committee

John Baker, US Department of Agriculture, and Department of Soil, Water, and Climate, University of Minnesota

Ann Banitt, US Army Corps of Engineers

Jeff Berg, Minnesota Department of Agriculture

John Bilotta, MN Sea Grant, University of Minnesota Extension

Mark Brigham, US Geological Survey

Tina Carstens, Ramsey-Washington Metro Watershed District

Heather Dorr, College of Continuing Education, University of Minnesota

Bill Douglass, Bolton & Menk, Inc.

*Lisa Goddard, S*RF Consulting Group, Inc.

John Gulliver, Department of Civil, Environmental, and Geo- Engineering, College of Science and Engineering, University of Minnesota

Lorin K. Hatch, HDR Engineering, Inc.

Andrea Hendrickson, Minnesota Department of Transportation

**Karen Jensen,* Metropolitan Council

Lucinda Johnson, Natural Resources Research Institute, University of Minnesota

Stephanie Johnson, Mississippi Watershed Management Organization

Ron Leaf, Short Elliott Hendrickson, Inc.

Zack McGough, College of Continuing Education, University of Minnesota

Salam Murtada, Department of Natural Resources, Division of Waters

Randy Neprash, Minnesota Cities Stormwater Coalition & Stantec

**Jeffrey Peterson,* Water Resources Center, University of Minnesota

Amit Pradhananga, Department of Forest Resources, University of Minnesota

Shawn Schottler, St. Croix Watershed Research Station

Wayne Sicora, Natural Resource Group

Faye Sleeper, Water Resources Center, University of Minnesota

Gene Soderbeck, Minnesota Pollution Control Agency

James Stark, U.S. Geological Survey

Katy Thompson, ASCE Representative and WSB & Associates, Inc.

Stew Thornley, Minnesota Department of Health

Rick Voigt, Voigt Consultants, LLC

Greg Wilson, Barr Engineering Company

Brad Wozney, Minnesota Board of Soil and Water Resources

** Committee Co-Chairs*

Minnesota Water Resources Conference

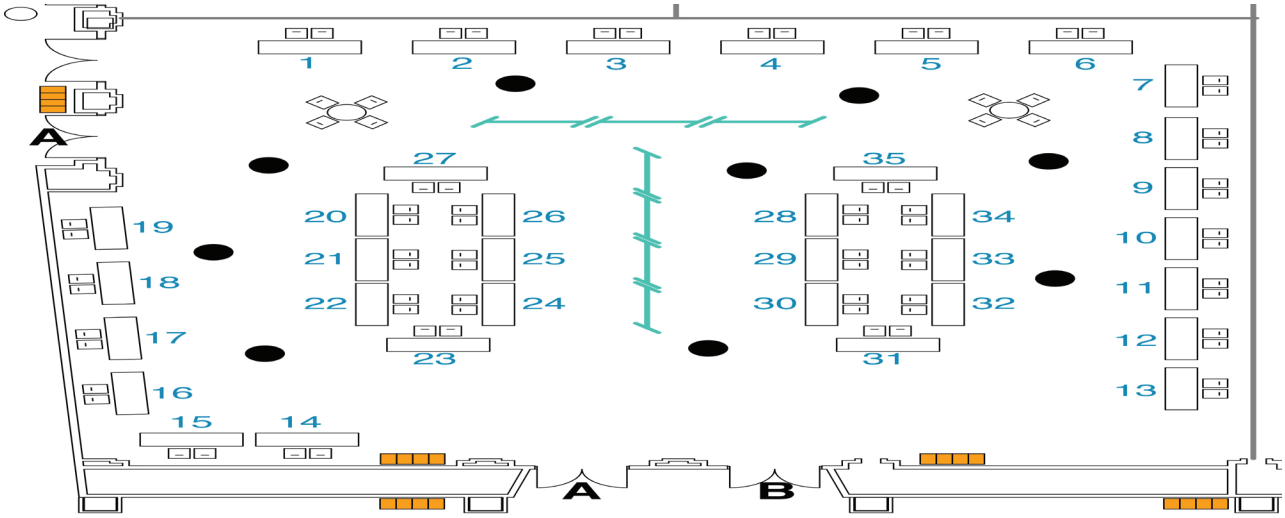
October 18–19, 2016

Thank you to our exhibitors

Department of
Civil, Environmental,
and Geo- Engineering
UNIVERSITY OF MINNESOTA

Minnesota Water Resources Conference

Exhibitors



Program Schedule – Tuesday, October 18, 2016

8:00–8:10 a.m. **Welcome Grand Ballroom**
Jeff Peterson, Water Resources Center, University of Minnesota and *Karen Jensen,* Metropolitan Council

8:10–8:20 a.m. **Dave Ford Water Resources Award**

8:20–9:30 a.m. **Plenary Session**
The Flint Water Crises: Lessons for Improved Governance and Oversight
Chris Kolb, President of the Michigan Environmental Council and Co-chair of the Flint Water Advisory Task Force

9:30–10:00 a.m. **Break Ballroom AB**

10:00–11:30 a.m. Concurrent Sessions I

Track A Ballroom E

Special Session Panel Discussion
Social Justice in Water Supply

Moderator: *Wanda Kirkpatrick,* Metropolitan Council, Director of Equal Opportunity Office

Co-Moderator: *Andrea Hendrickson*, Minnesota Department of Transportation

What is the impact to society of not providing high-quality water from water supply systems? Is Flint a symptom of a bigger problem? What are the issues, the disparities and what can be done about it? This session will convene a panel of experts to explore issues related to social justice in water supply. Following short presentations by the panelists there will be a moderated panel discussion and an opportunity for audience questions.

Ruth Hubbard, Minnesota Rural Water Association

Chris Kolb, Flint Water Advisory Task Force

Danette McCulley, Minneapolis Division of Water Treatment and Distribution Services

John Linc Stine, Commissioner, Minnesota Pollution Control Agency

Track B Ballroom F

Managing Biota of Lakes and Streams

Moderator: *Lorin Hatch*, HDR Engineering, Inc

Co-Moderator: *Lucinda Johnson,* Natural Resources Research Institute, University of Minnesota

Assessment of Common Carp at a Watershed Scale and Implications for Management

Justine Dauphinais, Reid Swanson, and Peter Sorensen, University of Minnesota

Role of Invasive Dreissenid Mussels in Restructuring Nutrient Dynamics in in Minnesota Lakes

Felicia Williamson, University of Minnesota Duluth

Restoration of Critical Trout Habitat in Remote Reaches of the Blackhoof River

John Lenczewski, Minnesota Trout Unlimited; *Jason Naber, Kevin Biehn, and Luke Johnson,* Emmons and Olivier Resources

Impact of Rainbow Trout Stocking Moratorium on Zooplankton Community Structure and Water Quality of Square Lake

Leif Hembre, Hamline University; *Meghan Funke*, Emmons and Olivier Resources, Inc; *Jim Shaver*, Carnelian-Marine St. Croix Watershed District

Track C Rooms 1-3

Planning Sustainable Practices

Moderator: *Bill Douglass*, Bolton & Menk, Inc

Co-Moderator: *Katy Thompson*, WSB & Associates, Inc

Developing a Stormwater Reuse Irrigation Assessment Planning Tool to Reduce Reliance on Groundwater

Phil Belfiori and Catherine Nester, Rice Creek Watershed District; *Mark Deutschman, Rachel Olm, Kate MacDonald, and Drew Kessler,* Houston Engineering, Inc

Cottageville Park: Integration of Land Use Planning and Natural Resources Improvements to Build Sustainable Communities

Renae Clark, Minnehaha Creek Watershed District; *Chris Meehan*, Wenck Associates

SWLRT—Regulatory Complexity

Jim Alexander, Southwest Light Rail Transit Project Office; *Earth Evans*, WSB & Associates, Inc; *Brady Busselman*, Sambatek; *Charlie Howley*, Hansen Thorp Pellinen Olson, Inc

Embracing Sustainable Stormwater Management at the University of Minnesota

Erin Hunker, SRF Consulting Group; *Cathy Abene,* University of Minnesota

Track D Rooms 4-6

N & P Measuring, Monitoring, Modeling, and Management

Moderator: *Jeff Berg*, Minnesota Department of Agriculture

Co-Moderator: *Greg Wilson*, Barr Engineering Company

Availability of Phosphorus in Sediment from Lake Superior and Its Watershed

Tayler Hebner, Gustavo Merten, Ajan Ajanic, Elizabeth Hill, Sandra Brovold, and Robert W. Sterner, University of Minnesota Duluth

Measuring and Modeling Phosphorus Loss and Transport in the LeSueur River Basin

Brent Dalzell, Department of Soil, Water, and Climate, University of Minnesota; *Jacques Finlay, Amy Hansen, and Christy Dolph*, University of Minnesota

Overview of the Nitrogen Fertilizer Rule

Katie Wolf, Annie Felix-Gerth, and Larry Gunderson, Minnesota Department of Agriculture

Evaluating Nitrogen Management and Crop Yield Through On-Farm Field Trial Demonstrations

Spencer Herbert, Margaret Wagner, Ryan Lemickson, Dawn Bernau, and Aaron Janz, Minnesota Department of Agriculture

*Underlined names are on-site presenters

11:30 a.m.–12:15 p.m. **Lunch Grand Ballroom** *Karen Jensen,* Metropolitan Council

12:15–1:00 p.m. **Luncheon Presentation,** Introduction: *John Downing,* Director, Minnesota Sea Grant
Federal/State Partnerships in Atmospheric and Coastal Research
Craig McLean, Assistant Administrator, Oceanic and Atmospheric Research, National Oceanic and Atmospheric Administration, United States Department of Commerce

1:15–2:45 p.m. Concurrent Sessions II

Track A Ballroom E

Social Science Applications in Conservation and Citizen Education

Moderator: *Amit Pradhananga,* Department of Forest Resources, University of Minnesota

Co-Moderator: *Brad Wozney,* Minnesota Board of Soil and Water Resources

Building Soil and Water Conservation District Staff Capacity for Groundwater Protection

Amit Pradhananga, Department of Forest Resources, University of Minnesota; *Sharon Pfeifer,* Minnesota Department of Natural Resources; *Mae A. Davenport*, University of Minnesota

Using Social Science to Accelerate Conservation

Peggy Knapp, Freshwater Society

Inspiring Elected and Appointed Community Leaders to Take Action Accomplished Through Education and Training: How Workshops-On-The-Water Build Knowledge and Result in Action and Behavior Changes

John Bilotta, University of Minnesota Extension and Sea Grant Program

Conservation Leverage Points in Rural Minnesota: Learning from Citizens in the Watonwan River Watershed

Dustin Anderson, Greater Blue Earth River Basin Alliance; *Kimberly Musser*, Water Resources Center Minnesota State University–Mankato; *Paul Davis*, Minnesota Pollution Control Agency

Track B Ballroom F

Climate Change Impacts

Moderator: *Andrea Hendrickson*, Minnesota Department of Transportation

Co-Moderator: *Katy Thompson*, WSB & Associates, Inc

Projected Impacts of Climate and Forest Change on Lake Superior Hydrology and Biology

William (Bill) Herb, St. Anthony Falls Lab, University of Minnesota; *Kristen Blann*, The Nature Conservancy; *Lucinda Johnson*, Natural Resources Research Institute, University of Minnesota; *Will Bartsch*, Environmental Protection Agency, Midcontinent Ecology Division; *Meijun Cai*, Natural Resources Research Institute, University of Minnesota; *John Jereczek*, Minnesota Department of Natural Resources; *Ralph Garono*, Natural Resources Research Group

Examining Community Resilience in Extreme Climatic Conditions

Rebecca Teasley, University of Minnesota Duluth; *Karlyn Eckman*, University of Minnesota; *Courtney Kowalczak*, Environmental Institute Director, Fond du Lac Tribal and Community College; *Dawn Newman*, American Indian and Tribal Partnership Liaison, University of Minnesota Extension; *Tashi Gulrung*, Sea Grant Graduate

The following 3 presentations by the Army Corp of Engineers will fill 40 minutes

Downscaled Climate Change Data Acquisition

Brian Alberto, Pat Foley, and Ann Banitt, United States Army Corps of Engineers

Case Study for Climate Change in Fargo, ND, Using Bias Corrected Spatially Disaggregated (BCSD) Data

Brian Alberto, Pat Foley, and Ann Banitt, United States Army Corps of Engineers

Incorporation of Climate Change Impacts into Hydrologic Analysis

Chanel Mueller and Bryan Baker, United States Army Corps of Engineers

Track C Rooms 1-3

BMPs for Urban Retrofits

Moderator: *Tina Carstens*, Ramsey-Washington Metro Watershed District

Co-Moderator: *Lisa Goddard*, SRF Consulting Group, Inc

Building an Urban Stormwater Treatment Testbed

Marcy Bean, Mississippi Watershed Management Organization; *William Alms*, WSB & Associates, Inc; *Doug Snyder*, Mississippi Watershed Management Organization

Irrigate, Infiltrate, Automate: Stormwater Reuse at Upper Villa Park

Forrest Kelley, Capitol Region Watershed District

Tree Trench and Permeable Pavers in the Edison High School Parking Lot

Michelle Neu, Mississippi Watershed Management Organization; Dan Edgerton and Mark Statz, Stantec Consulting, Inc

Sustainable Stormwater Analysis for the Ford Site Redevelopment, Saint Paul, MN

Robert Fossum, Capitol Region Watershed District; *Wes Saunders-Pearce*, City of Saint Paul

Track D Rooms 4-6

Groundwater and Surface Water Interactions

Moderator: *Karen Jensen*, Metropolitan Council

Co-Moderator: *Salam Murtada,* Department of Natural Resources, Division of Waters

Estimating Groundwater Recharge to Buried Aquifers

Alyssa Witt, Jared Trost, and James Stark, United States Geological Survey; William Simpkins, Iowa State University

Characterizing Groundwater and Surface-Water Interactions in Selected Northeastern Twin Cities Lakes, Minnesota—Part 1: Statistical Analysis and Field Data Collection

Perry Jones, Jared Trost, Donald O. Rosenberry, Aliesha Diekoff, and Daniel Morel, United States Geological Survey

Characterizing Groundwater and Surface-Water Interactions in Selected Northeastern Twin Cities Lakes, Minnesota—Part 2: Groundwater Flow Model

Jason Roth, Perry Jones, and Catherine Christenson, United States Geological Survey

Water Budget Changes from Wetland and Prairie Restoration, Glacial Ridge National Wildlife Refuge, Northwestern Minnesota, 2006–13

Tim Cowdery and Catherine Christenson, United States Geological Survey

*Underlined names are on-site presenters

2:45–3:15 p.m. **Break Ballroom AB**

3:15–4:45 p.m. Concurrent Sessions III

Track A Ballroom E

Community Engagement and Perspectives

Moderator: *Faye Sleeper*, Water Resources Center, University of Minnesota

Co-Moderator: *Amit Pradhananga*, Department of Forest Resources, University of Minnesota

The 2016 State of the River Report

Trevor Russell, Friends of the Mississippi River; *Lark Weller*, National Park Service—Mississippi National River and Recreation Area

The Easement Experience

Michael Lynn and Alan Singer, Dakota County

We Think We Can? Collective Efficacy and Community Perspectives on Climate, Extreme Weather, and Water Management in Minnesota's Lake Superior Basin

Vanessa Perry and Mae Davenport, University of Minnesota; *George Host*, University of Minnesota Duluth

Using the Agricultural Conservation Planning Framework to Analyze Minnesota Watersheds

Ann Lewandowski and Les Everett, Water Resources Center, University of Minnesota

Track B Ballroom F

Modeling and Managing Nutrient and Thermal Drivers of Aquatic Habitat

Moderator: *Brad Wozney*, Minnesota Board of Water and Soil Resources

Co-Moderator: *Randy Neprash*, Minnesota Cities Stormwater Coalition, and Stantec

Using Predictive Lake Modeling to Assess the Development of Cyanobacteria Blooms

Richard Kiesling and Erik Smith, United States Geological Survey

Protecting Minnesota's Rivers with New River Eutrophication Standards

Dennis Wasley, Liz Kaufenberg, Matt Lindon, and Steve Weiss; Minnesota Pollution Control Agency

Climate Change Simulations of Cold-Water Fish Habitat in Elk Lake, Minnesota Using a Predictive Mechanistic Lake Model

Erik Smith and Richard Kiesling, United States Geological Survey

Track C Rooms 1-3

Innovative Urban BMPs

Moderator: *Stephanie Johnson*, Mississippi Watershed Management Organization

Co-Moderator: *Ron Leaf*, Short Elliott Hendrickson, Inc

Iron-Enhanced Ditch Checks for Capturing Phosphorus in Runoff

Poornima Natarajan and John Gulliver, University of Minnesota; *Barbara Loida, Nicholas Olson, David Bauer, James Michael, and Scot Way,* Minnesota Department of Transportation; *Kristine Giga and Ryan Johnson*, City of Roseville

Pump and Treat Iron Enhanced Stormwater Treatment in a Neighborhood Setting

Karen Kill, Brown's Creek Watershed District; *Derek Lash and Ryan Fleming*, Emmons and Olivier Resources, Inc

Multiple Benefits of Privately Shared Stormwater Systems: From Conceptual Design to Construction

Nathan Campeau, Barr Engineering Company, *Dan Kalmon*, Mississippi Watershed Management Organization

Urban School Retrofits: Sending Stormwater to Detention

Nate Zwonitzer, Capitol Region Watershed District

Track D Rooms 4-6

Groundwater and Surface Water Supply Management

Moderator: *Karen Jensen*, Metropolitan Council

Co-Moderator: *Jeffrey Peterson*, Water Resources Center, University of Minnesota

Enhancing Groundwater Sources Through Enhanced Aquifer Recharge to Improve Water Supply Reliability

Kathryn Jones and Adam Kessler, HDR Engineering, Inc; *David Brown*, Metropolitan Council; *Kelton Barr*, Braun Intertec

Managing Groundwater at the Local Level

Steve Woods, Freshwater Society

2015 Reconnaissance Study of Pesticide Compounds in Community Public Water Supply Wells

Heather Johnson, Minnesota Department of Agriculture; *David Rindal, Anna Schliep, and Todd Johnson*, Minnesota Department of Health

Historical Trends and Spatial Distribution of Antibiotics in Minnesota Lakes and Rivers

Jill Kerrigan, William Arnold, Kyle Sandberg, and Tim LaPara, University of Minnesota; Daniel Engstrom, St. Croix Watershed Research Station

*Underlined names are on-site presenters

4:45 – 5:45 **Reception and Poster Session Ballroom AB**

Program Schedule – Wednesday, October 19, 2016

8:00–8:10 a.m. **Welcome Grand Ballroom**
Jeffrey Peterson, Water Resources Center, University of Minnesota

8:10–9:30 a.m. **Plenary Session**
Nonpoint Source Water Quality Issues and Solutions
David Mulla, Professor and Larson Endowed Chair in Soil and Water Resources, University of Minnesota

9:30–10:00 a.m. **Break Ballroom AB**

10:00–11:30 a.m. Concurrent Sessions IV

Track A Ballroom E

Prioritizing Sediment Reduction Strategies in a Large Watershed: Collaborative for Sediment Source Reduction

Moderator: *Gene Soderbeck*, Minnesota Pollution Control Agency

Co-Moderator: *Shawn Schottler*, St. Croix Watershed Research Station

Karen Gran, University of Minnesota Duluth; *Se Jong Cho and Ben Hobbs*, Johns Hopkins University; *Peter Wilcock and Patrick Belmont*, Utah State University

I. Greater Blue Earth River Basin: Sediment Sources, Sinks, and Delivery

Karen Gran, University of Minnesota Duluth

II. Simulation Model to Link Management Choices and Sediment Delivery

Se Jong Cho, Johns Hopkins University

III. Linking Research and Management Choices at the Watershed Scale

Peter Wilcock, Utah State University

Track B Ballroom F

Creeks, Ponds, Wetlands, and Swales

Moderator: *Tina Carstens*, Ramsey-Washington Metro Watershed District

Co-Moderator: *John Gulliver*, Department of Civil, Environmental, and Geo-Engineering, College of Science and Engineering, University of Minnesota

Application of the Minnesota Dry Swale Calculator

Maria Garcia-Serrana, University of Minnesota–St. Anthony Falls Laboratory; *John Gulliver and John L. Nieber,* University of Minnesota

Diagnosing and Mitigating Urban Wetland Impacts on Downstream Water Resources

Diane Spector, Jeff Strom, Ed Matthiesen, and Joe Bischoff, Wenck Associates, Inc

Stormwater Pond and Wetland Performance Study in Ramsey-Washington Metro Watershed District

Michael McKinney, Erin Anderson Wenz, and Jennifer A., Koehler, Barr Engineering Company

Implementing a Natural Channel Design—Minnehaha Creek

Jonathon Kusa, Inter-Fluve, Inc; *Michael Hayman*, Minnehaha Creek Watershed District

Track C Rooms 1-3

Engineering Water Systems

Moderator: *Randy Neprash*, Minnesota Cities Stormwater Coalition, and Stantec

Co-Moderator: *Wayne Sicora*, Natural Resource Group

Applying Multiple Assessment Techniques to Minimize Disturbance and Select Suitable Natural Stream Stabilization Practices

Lisa Odens and Greg Bowles, Houston Engineering; *Matt Moore,* South Washington Watershed District

Elm River Intake Project—Innovative Solutions Transformed the Way Aberdeen Receives Its Water

Kent Torve, Wenck Associates, Inc; *Don Weigel,* Clark Engineering

Phosphorus Removal Evaluation at Mankato Wastewater Treatment Plant Done by Student-Professional Collaboration

Stephen Druschel and Bridget Anderson, Minnesota State University–Mankato

Developing a Stressor-Response Concept Model for Red River of the North

Bruce Wilson, Erich Weber, and Julie Blackburn, RESPEC

Track D Rooms 4-6

Targeting Tools for Planning and Implementation

Moderator: *Brad Wozney,* Minnesota Board of Soil and Water Resources

Co-Moderator: *Jeff Peterson,* Water Resources Center, University of Minnesota

Pilot Red Lake River One Watershed, One Plan

Red Lake River Planning Group, Local Governing Units; *Nate Dalager*, HDR, Inc

Optimizing Conservation Using the Scenario Application Manager (SAM)

Julie Blackburn, RESPEC Consulting and Services

Implementing the PTMapp GIS Toolset at Smaller Watershed Scales: Results and Lessons Learned

Jason Ulrich and Joe Pallardy, Emmons and Olivier Resources Inc

Grid-Cell SWAT Modeling Breaks New Ground on Isolating Pollutant Source Areas and Quantifying BMP Benefits

Greg Wilson and Evan Christianson, Barr Engineering Company

Track E Rooms 7-9

Waters of the United States Rules

Moderator: *William Douglass,* Bolton & Menk, Inc.

Co-Moderator: *Karen Jensen,* Metropolitan Council

Wetland Protection vs. Drainage Rights

Rinke Noonan, Attorneys at Law, St. Cloud, Minnesota; *Don Parrish*, American Farm Bureau Federation, Sr. Director of Regulatory Issues; *Scott Strand,* Environmental Law and Policy Center (

ELPC)

*Underlined names are on-site presenters

11:30 a.m.–12:15 p.m. **Lunch Grand Ballroom**
Karen Jensen, Metropolitan Council and *Jeffrey Peterson,* Water Resources Center, University of Minnesota

12:15–1:00 p.m. **Luncheon Presentation** Introduction: *John Linc Stine*, Commissioner, Minnesota Pollution Control Agency
Remarks, The Honorable *Mark Dayton*, Governor of Minnesota
Further remarks and questions from the audience; *John Linc Stine,* Commissioner, Minnesota Pollution Control Agency

1:15–2:45 p.m. Concurrent Sessions V

Track A Ballroom E

Near Channel Sediment Erosion

Moderator: *Shawn Schottler*, St. Croix Watershed Research Station

Co-Moderator: *Gene Soderbeck*, Minnesota Pollution Control Agency

Influences on Lateral Erosion Rates in Three Agriculture-Dominated Minnesota Watersheds

Jen Oknich, Chris Lenhart, Gary Sands, Mikhail Titov, Ben Underhill, and Laura Triplett, University of Minnesota; Mark Ellefson, Department of Natural Resources

Sediment Load Reduction Treatments in MN River Valley Streams

Martin Melchior, Inter-Fluve*; Ryan Holzer and Paul Nelson,* Scott County

Discharge-TSS Relations Yield Useful Information Regarding Controls on Fine Sediment Production and Transport in Rivers Throughout Minnesota

Angus Vaughan and Patrick Belmont, Utah State University

Historical Landslide Inventory for the Twin Cities Metropolitan Area

Carrie Jennings, Freshwater Society; *Mary Presnail and Suzanne Jiwani,* Department of Natural Resources; *Ethan Kurak, Jessica Palazzolo, and Joshua M. Feinberg*, University of Minnesota; *Rachel Meier*, Gustavus Adolphus College; *Craig Schmidt,* National Weather Service; *Eric Waage,* Hennepin County Emergency Management

Track B Ballroom F

Fine-scale Measurement and Targeting of Agricultural Practices

Moderator: *Jeff Berg*, Minnesota Department of Agriculture

Co-Moderator: *Faye Sleeper*, Water Resources Center, University of Minnesota

Water Quality Models for Establishing Site-Specific Nutrient Goals Based on Water Quality and Biological Response Variables

David Dilks, Hans Holmberg, and Dendy Lofton, LimnoTech

Targeting Conservation Opportunities to Retain Water: Working Towards Altered Hydrology Goals

Jun Yang, Mark Deutschman, Zach Hermann, and Drew Kessler, Houston Engineering, Inc

Clay County Drainage Site: Field Scale Drainage Research in the Minnesota Red River Valley

Stefan Bischof, Minnesota Department of Agriculture

Runoff Risk: A Decision Support Tool for Nutrient Application Timing

Dustin Goering, Steve Buan, and Liz Houle, National Oceanic and Atmospheric Administration, National Weather Service; *Heather Johnson,* Minnesota Department of Agriculture

Track C Rooms 1-3

Urban Water Quality

Moderator: *Ron Leaf*, Short Elliott Hendrickson, Inc

Co-Moderator: *Brian Beck,* Wenck Associates

Alum Sulfate (Alum) Treatment Facility: 18 Years of Results

Eric Korte, Ramsey Washington Metro Watershed District

Implementing an Adaptive Management Approach for an Alum Treatment on Bald Eagle Lake, MN

Brian Beck and Joe Bischoff, Wenck Associates; *William James*, University of Wisconsin; *Matt Kocian,* Rice Creek Watershed District; *John Holz and Tad Barrow,* HAB Aquatic Solutions

Automated Baseflow/ Stormflow Separation and Load Calculation for Continuous Flow Data and Water Quality Samples in Urban Storm Sewers

Britta Suppes, Joe Sellner, and Bob Fossum, Capitol Region Watershed District

Treating Direct Discharges and Reducing Pollutant Loads to the Mississippi River: A Regional Approach to Implementing Green Infrastructure in the NE Industrial Area

Lisa Vollbrecht and Noah Czech, City of Saint Cloud; *April Ryan*, SEH Inc

Track D Rooms 4-6

Bridge and Infrastructure Issues

Moderator: *Rick Voigt*, Voigt Consultants, LLC

Co-Moderator: *Andrea Hendrickson*, Minnesota Department of Transportation

Two- and Three-Dimensional Simulation of Bridge Pier Scour Development in the Mississippi River

Nicole Bartelt, Petra DeWall, and Solomon Woldeamlak, Minnesota Department of Transportation; Fotis Sotiropoulos, *Ali Khosronejad, and Trung Le*, St. Anthony Falls Laboratory, University of Minnesota

Mitigating Bridge Scour Case Study from the I-90 River Bridge and Interchange Reconstruction

Nicole Bartelt and Petra DeWall, Minnesota Department of Transportation; *Lisa Goddard*, SRF Consulting Group

Drainage Dilemmas in Bluff Country—Case Studies from the I-90 River Bridge and Interchange Reconstruction

Jeremy Nielsen and Lisa Goddard, SRF Consulting Group, Inc

Trunk Highway 53 Location

Jonathan Libby, Kimley-Horn, *and Patrick Huston*, Minnesota Department of Transportation

LID Workshop Rooms 7-9

Stormwater Research Priorities and Pond Maintenance Research Project

A Stormwater/LID Extended Session

Moderator: *John Bilotta*

Multiple presenters from the research team cited below.

1:15 p.m.

Project overview and session objectives

This research project is developing information required to improve stormwater pond maintenance and create a ten-year framework of stormwater research needs.

1:20–1:45 p.m.

PAH and Phosphorus Release from Stormwater Ponds—Research Quickbyte

An overview of a current research project (2016–18). What is being studied, how, and why.

1:45–2:45 p.m.

Minnesota Stormwater Research Framework and Priorities

An overview of the project (2016–18) including project design, input from existing research and databases, and summary of an interim needs report.

*Underlined names are on-site presenters

2:45–3:00 p.m. **Break Ballroom AB**

3:00–4:30 p.m. Concurrent Sessions VI

Track A Ballroom E

River Hydrology and Suspended Sediment

Moderator: *Gene Soderbeck,* Minnesota Pollution Control Agency

Co-Moderator: *Shawn Schottler,* St. Croix Watershed Research Station

Modeling the Influences of Riverine Hydrology on Near-Channel Nesting Habitat for State-Listed Turtle Species

Jason Naber, Jason Ulrich, and Mike Talbot, Emmons and Olivier Resources

Application of Dimensionless Sediment Rating Curves to Predict Suspended-Sediment Concentrations, Bedload, and Annual Loads for Rivers in Minnesota

Joel Groten, Christopher Ellison, and David Lorenz, United States Geological Survey; *Karl Koller,* Minnesota Department of Natural Resources

Indicators for Altered Hydrologic Influences on Fluvial Geomorphology and Sediment Loading

Alex Schmidt, Greg Bowles, and Drew Kessler, Houston Engineering

Flow-Related Dynamics in Suspended Algal Biomass and its Contribution to Suspended Particulate Matter in an Agricultural River Network of the Minnesota River Basin, USA

Christy Dolph, Amy Hansen, and Jacques Finlay, University of Minnesota

Track B Ballroom F

Watershed Monitoring Assessment and Dissemination

Moderator: *Greg Wilson,* Barr Engineering Company

Co-Moderator: *Salam Murada,* Department of Natural Resources, Division of Waters

An Interactive Application for Graphing and Downloading Daily, Annual, and Average Pollutant Load Data from the MPCA's Watershed Pollutant Load Monitoring Network

Patrick Baskfield and Casey Scott, Minnesota Pollution Control Agency

Estimating Daily Streamflow for Ungaged Stream Locations in Minnesota

Jeff Ziegeweid, Christopher Sanocki, and David Lorenz, United States Geological Survey Minnesota Water Science Center

Long-Term Trends in Concentration and Loads of Stream Pollutants in Minnesota

James MacArthur and James Jahnz, Minnesota Pollution Control Agency

Comparing Minnesota's Nutrient and Sediment Load Monitoring Results with Watershed Characteristics

David Wall and Thomas Pearson, Minnesota Pollution Control Agency; *Ben Gosack,* Minnesota Department of Natural Resources

Track C Rooms 1-3

New Tools for Salt Management

Moderator: *Lisa Goddard,* SRF Consulting Group, Inc

Co-Moderator: *John Gulliver,* Department of Civil, Environmental, and Geo-Engineering, College of Science and Engineering, University of Minnesota

Smart Salting: Managing Salt Use to Protect the Environment, Save Money and Provide Public Safety

Brooke Asleson and Rachel Olmanson, Minnesota Pollution Control Agency

Winter Maintenance Assessment Tool: An Innovative Planning Tool to Manage Salt Use

Matt Morreim, City of Saint Paul Public Works; *Brooke Asleson,* Minnesota Pollution Control Agency; *Craig Eldred,* City of Waconia

Using "Big Data" Techniques to Analyze and Visualize Dissolved Salt Concentrations Across the Minnesota Landscape

Scott Kyser , Andreas Hochrein and Casey Scott, Minnesota Pollution Control Agency

Revised Sulfate Standard to Protect Wild Rice from Elevated Hydrogen Sulfide

Edward Swain, Phil Monson, and Shannon Lotthammer, Minnesota Pollution Control Agency

Track D Rooms 4-6

Planning for Floods, Fish Passage, and Flocculation

Moderator: *Ann Banitt,* United States Army Corps of Engineers

Co-Moderator: *Rick Voigt,* Voigt Consultants, LLC

Mitigating Geyser Events in the Minneapolis Stormwater Tunnel Systems

Brandon Barnes, Greg Fransen, Lulu Fang, Christian Frias, and Omid Mohseni, Barr Engineering Company

Development of Planning Toolsets using XP-SWMM and GIS Systems to Address Flood Risk, Climate Change, and Urban and Rural Development

Bryce Cruey and Ed Matthiesen, Wenck Associates, Inc

Culvert Inventory and Ranking Protocol

Amanda Hillman, Minnesota Department of Natural Resources

Flocculation BMPs for Reducing the Sediment in Construction Water Discharges

Stephen Druschel and Nazli Yilmaz Wodzinski, Minnesota State University–Mankato

LID Workshop Rooms 7-9

3:00–4:30 p.m.

Stakeholder Input for Stormwater Research Priorities for the Next Decade

This will be an interactive input session (not a presentation). Participants will be invited to provide input to help shape future surveys and methods, and contribute to stormwater research needs.

This stormwater/LID extended session will be led by members of the UMN research team carrying out this project including:

Jeff Peterson, Larry Baker, John Bilotta, John Chapman, Jacques Finlay, John Gulliver, Raymond Hozalski, Shahram Missaghi, Matt Simcik, and Bruce Wilson, and may feature multiple post-docs and graduate students.

4:30 **Adjourn**

*Underlined names are on-site presenters

Poster Display

The following posters will be displayed during the breaks each day. The poster session with poster presenters will be held on Tuesday evening, during the reception.

---

1. In-Lake Response to Watershed Restoration: Lake Shaokotan, Lincoln County, MN
Ellen Albright, Macalester College; *Steven Heiskary,* Minnesota Pollution Control Agency

2. Sampling and Temporal Effects on Arsenic Concentration in New Private Residential Wells in Minnesota
Emily Berquist, Minnesota Department of Health; *Melinda Erickson,* United States Geological Survey

3. Woodchip Bioreactors: From Planning to Construction, a case study of Faribault County Ditch (CD) 62
Chuck Brandel, ISG

4. An ArcGIS-Based Tool for Water Table Interpolation
Catherine Christenson and Tim Cowdery, US Geological Survey

5. Floating Treatment Wetlands in a Northern Climate: Examination of Phosphorus and Nitrogen Removal
Emily Deering, Joseph Magner, Chris Lenhart, and Lawrence Baker, University of Minnesota

6. Fields to Streams: Managing Water in Rural Landscapes
Les Everett and Ann Lewandowski, University of Minnesota Water Resources Center; *Karen Terry,* University of Minnesota Extension

7. Identifying Opportunities for Minnesota's One Watershed, One Plan Program
Elizabeth Henley, University of Minnesota

8. Trend Assessment of Regional River Water Quality in the Twin Cities Metropolitan Area (1976–2014)
Erik Herberg and Hong Wang, Metropolitan Council

9. Evaluating Nitrogen Management and Crop Yield Through On-Farm Field Trial Demonstrations
Spencer Herbert, Margaret Wagner, Ryan Lemickson, Dawn Bernau, and Aaron Janz, Minnesota Department of Agriculture

10. Embankment Protection During Road Overtopping Events
Matthew Hernick, Jeff Marr, Sara Mielke, and Robert Gabrielson, University of Minnesota St Anthony Falls Laboratory; *Craig Taylor,* LimnoTech

11. Building Capacity for Natural Resources Across RSDPs
Linda Kingery and *Rose Clarke,* University of Minnesota Extension Regional Sustainable Development Partnerships

12. The Passage Bench: A Review of their Construction as a Standard Bridge Design on River Crossings in Minnesota
Peter Leete, Minnesota Department of Natural Resources, Minnesota Department of Transportation

13. Rice Creek Commons Comprehensive Stormwater Management Plan
Jonathan Libby, Kimley-Horn & Associates, Inc.
Pamela Massaro, Wenck Associates

14. Sunlight-Driven Transformation of Contaminants of Emerging Concern in Stormwater
Andrew McCabe and *William Arnold* University of Minnesota, Department of Civil, Environmental, and Geo- Engineering

15. Seasonal Changes in the Turbidimeter Signal Due to Sediment Color in a Minnesota River Tributary
Gustavo Merten, University of Minnesota, Duluth; *Paul Capel,* University of Minnesota, United States Geological Survey

16. Idea of a Minnesota Water Resources Modeling Group Revisited
Shahram Missaghi, Minnesota Extension

17. Local Water Supply Planning
Carmelita Nelson, Minnesota Department of Natural Resources
Lanya Ross, Metropolitan Council

18. Alum's Critical Role in Controlling Algae and Phosphorus
Keith Pilgrim and Greg Wilson, Barr Engineering Company

19. Advancing Groundwater Implementation through GRAPS
Carrie Raber and Mark Wettlaufer, Minnesota Department of Health

20. The R/V Blue Heron and the Large Lakes Observatory
Richard Ricketts, Large Lakes Observatory, University of Minnesota

21. Nearshore Lake Superior Periphyton Surveillance
Elaine Ruzycki, Richard Axler, and Jerry Henneck, Natural Resources Research Institute, University of Minnesota, Duluth; *Jeremy Erickson,* Saint Paul Regional Water Services

22. Illicit Discharge Detection and Elimination Education Program
Leslie Stovring, City of Eden Prairie; *Leah Gifford and Walter Eshenaur,* SRF Consulting Group, Inc.

Poster Display (continued)

The following posters will be displayed during the breaks each day. The poster session with poster presenters will be held on Tuesday evening, during the reception.

---

23. Comparison of Alternative Media for the Construction of Stormwater Biofiltration Systems
Josh Swanson, University of Minnesota, Duluth, *Meijun Cai*, University of Minnesota Duluth, Natural Resources Research Institute, *Kurt Johnson*, University of Minnesota Duluth, Natural Resources Research Institute, *David Saftner* and *Rebecca Teasley,* Department of Civil Engineering, University of Minnesota Duluth

24. Phosphorus in the Shell Rock Watershed
Bill Thompson, Minnesota Pollution Control Agency

25. A Direct-Push Sample-Freezing Drive Shoe for Collecting Sediment Cores with Intact Pore Fluid, Microbial, and Sediment Distributions
Jared Trost and Barbara Bekins, United States Geological Survey; *Tom Christy,* Geoprobe Systems

26. Iron Oxide Mineral Nanoparticles: Fate and Transport of Nitrobenzene Pesticides
Jeanette Voelz, William Arnold, and R. Lee Penn, University of Minnesota, Twin Cities

27. Reliable Reduction of Agricultural Runoff: Tradeoffs Involving Variation of Water Quality
Zhiyu Wang and *Jay Coggins,* University of Minnesota

28. Linking Hydrologic Flux and Root Zone Geochemistry at Second Creek, a Sulfate-Enriched Wild Rice Stream in Northeastern Minnesota
Amanda Yourd, Gene-Hua Crystal Ng, Amy Myrbo, and Nathan Johnson, University of Minnesota, Twin Cities, Department of Earth Sciences

Minnesota Water Resources Conference

October 18-19, 2016
Saint Paul RiverCentre

175 West Kellogg Boulevard
Saint Paul, Minnesota

Book of Abstracts

Arranged by session in order of presentation
Index of first authors on page 80

Plenary Session 1 8:20 a.m. – 9:30 a.m.

The Flint Water Crises: Lessons for Improved Governance and Oversight

Chris Kolb, President of the Michigan Environmental Council and Co-Chair of the Flint Water Advisory Task Force

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track A: Special Session Panel Discussion Social Justice in Water Supply

Ruth Hubbard, Minneesota Rural Water Association; Chris Kolb, Flint Water Advisory Task Force; Danette McCulley, Minneapolis Division of Water Treatment and Distribution Services; John Linc Stine, Commissioner, Minnesota Pollution Control Agency

What is the impact to society of not providing high-quality water from water supply systems? Is Flint a symptom of a bigger problem? What are the issues, the disparities and what can be done about it? This session will convene a panel of experts to explore issues related to social justice in water supply. Following short presentations by the panelists there will be a moderated panel discussion and an opportunity for audience questions.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track B: Managing Biota of Lakes and Streams

Assessment of Common Carp at a Watershed Scale and Implications for Management

Justine Dauphinais (kochx174@umn.edu), Reid Swanson, and Peter Sorensen, University of Minnesota

Complex networks of interconnected lakes, streams, and wetlands are a ubiquitous feature of the Minnesota landscape. When attempting to manage mobile fishes, one must consider local hydrology, habitat heterogeneity, and patterns of fish movement and habitat use. The common carp (Cyprinus carpio), a highly invasive and damaging fish in Minnesota, is known to make long-distance migrations and utilize distinctive peripheral habitats for spawning. This complex life history strategy presents challenges to managers as it is often impractical to manage carp populations in individual lakes and difficult to determine appropriate management units. To develop a control strategy for common carp at a watershed scale, we initiated a three-year research project in 2014 to determine carp abundance and biomass, movement patterns, and recruitment patterns in a system of 15 interconnected lakes that comprise the Six Mile Creek Subwatershed in central Minnesota. This intensive study includes regular electrofishing surveys in each lake, monthly tracking of 120 radio-tagged carp, annual trapnet surveys in 21 water bodies, as well as supplementary aging, genetic, and microchemical analyses in several of the study lakes. Our findings to date suggest that there are multiple subpopulations of common carp within the subwatershed, varying degrees of mixing, and recruitment is restricted to a few locations in select years. This ongoing project is funded by the Minnehaha Creek Watershed District.

Role of Invasive Dreissenid Mussels in Restructuring Nutrient Dynamics in Minnesota Lakes

Felicia Williamson (will5189@umn.edu), University of Minnesota Duluth

Dreissenid (Zebra and Quagga) mussels were introduced to North America in the 1980s, and have colonized numerous freshwater systems, causing major ecological changes, including restructuring of nutrient dynamics. Although work has been done on dreissenid effects on elemental cycling, most studies are limited to a single system or single aspect of dreissenid effects, making it difficult to make general statements about dreissenid effects on nutrients in invaded systems. Our goal was to quantify and provide an integrated view of the role of invasive dreissenid mussels in biogeochemical dynamics through the development of nutrient budgets for 9 Minnesota lakes spanning large gradients of size and trophic status. We measured dreissenid living biomass, discarded shell mass, tissue and shell nutrient composition (C, N, and P), and excretion and biodeposition rates. Nutrient budgets were constructed for dreissenids in different types of lakes in the context of ecological stoichiometry and homeostasis theory. Our results provide new insights and a more holistic understanding of the role of dreissenid invaders in varying lake systems, which allows better prediction of dreissenid impacts on biogeochemistry of different lakes.

Restoration of Critical Trout Habitat in Remote Reaches of the Blackhoof River.

Luke Johnson (ljohnson@eorinc.com), Emmons & Olivier Resources; John Lenczewski, MN Trout Unlimited; Jason Naber, Emmons & Olivier Resources; Kevin Biehn, Emmons & Olivier Resources

Record rainfall and subsequent floodwaters in June 2012 caused severe erosion along the stream banks and valley walls of many streams throughout the Duluth area. On the Blackhoof River, a remote stream about 30 miles southwest of Duluth, sections of the river were clogged by mass wasting and tangles of trees that dammed flows and caused sediment aggradation. The result was long silted-in reaches of a river that were previously intact Steelhead, native brook trout, and brown trout habitat. In 2014 a field assessment was conducted along a 12-mile section of the Blackhoof River to identify habitat degradation and restoration priorities. The following year a restoration plan was developed to fit the remote location and limited access. Minnesota Trout Unlimited led the project and collaborated with MNDNR and Carlton County SWCD to implement a low-impact approach without the use of heavy equipment. Significant log jams were removed, slumping banks were stabilized, and sediment transport was reestablished, which restored spawning and rearing habitat for trout and Steelhead. For streams that have experienced channel degradation resulting from the 2012 flood, this low-impact approach may provide guidance for the restoration of similarly remote watersheds.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track B: Managing Biota of Lakes and Streams *(continued)*

Impact of Rainbow Trout Stocking Moratorium on Zooplankton Community Structure and Water Quality of Square Lake

Leif Hembre (lhembre@hamline.edu), Hamline University; Meghan Funke, Emmons & Olivier Resources, Inc; Jim Shaver, Carnelian-Marine St. Croix Watershed District

Square Lake (Washington County), which historically been among the clearest lakes in the Minneapolis-St. Paul metropolitan area, has experienced declining water clarity due to increased algal biomass over the past 35 years. Cause(s) for the eutrophication trend have yet to be conclusively determined, but recent research has identified predation by rainbow trout (annually stocked since the early 1980s by the Minnesota Department of Natural Resources (MDNR)), on large-bodied zooplankton grazers (Daphnia pulicaria) to be the likely cause for lake's eutrophication trend. To enable evaluation of the hypothesis that rainbow trout predation is responsible for the decline in the lake's water clarity, the MDNR imposed a three-year moratorium on trout stocking. Here we compare water quality and zooplankton community monitoring data from two years prior to the moratorium (2010 & 2012), to monitoring data from the three moratorium years (2013-2015) to evaluate the effects of this food web manipulation. Cessation of rainbow trout stocking resulted in several significant changes in the lake's zooplankton community and its water quality. These include: 1) an increase in the abundance and biomass of the large-bodied D. pulicaria, 2) a concomitant decrease in the abundance and biomass of a smaller-bodied Daphnia species (D. mendotae), 3) a more pronounced springtime clear-water phase when D. pulicaria reached its highest densities, and 4) increased water clarity (secchi depth) during. In addition, surface water algal biomass (Chl a) was lower (though not to a statistically significant degree), and dissolved oxygen in deep water persisted at higher concentrations in the 2013-2015 moratorium years compared to 2010 & 2012. In summary, results of the rainbow trout-stocking moratorium in Square Lake support the hypothesis that predation by trout on large-bodied herbivorous zooplankton is the primary cause for the pattern of eutrophication in Square Lake over the past several decades.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track C: Planning Sustainable Practices

Developing a Stormwater Reuse Irrigation Assessment Planning Tool to Reduce Reliance on Groundwater

Phil Belfiori (pbelfiori@ricecreek.org) and Catherine Nester, Rice Creek Watershed District; Mark Deutschman, Rachel Olm, Kate MacDonald, and Drew Kessler, Houston Engineering, Inc.

The majority of communities in the Twin Cities metropolitan area rely on groundwater as their primary public water supply. In recent years, there has been growing concern over the sustainability of pumping groundwater at current and projected rates and its effect on groundwater supplies in the area. Using a Clean Water Fund grant from the Board of Water & Soil Resources, the Rice Creek Watershed District has developed a watershed-scale planning tool (Stormwater Reuse Irrigation Assessment) to identify and prioritize potential locations suitable for stormwater reuse irrigation projects. Identifying and prioritizing potential reuse sites provides the opportunity to increase implementation of these projects, with the ultimate goal of reducing groundwater consumption. Using the tool, technically feasible sites are identified through a calculated ratio of the total contributing drainage area to the minimum drainage area required for sufficient runoff to meet the irrigation demands of the site. Sites that are identified as technically feasible are then prioritized using qualitative criteria that identify possible impacts (beneficial and adverse) of potential sites. The assessment was designed and is intended to be available for statewide use.

Cottageville Park: Integration of Land Use Planning and Natural Resources Improvesments to Build Sustainable Communities

Renae Clark (rclark@minnehahacreek.org), Minnehaha Creek Watershed District; Chris Meehan, Wenck Associates

Land use practices directly affect the quality of our lakes, rivers, and streams. Despite this cause-and effect relationship, there is a historical divide between land use planning and water resource management. Recently adopted policy "Balanced Urban Ecology," recognizes that the Minnehaha Creek Watershed (MCWD) is part of an intricate urban ecological system of natural and made-made parts. Further, it establishes our commitment to achieving sustainable communities by understanding the needs of local communities and land owners, and then forming creative partnerships to pursue our mutual goals.

Cottageville Park in the City of Hopkins is a highlight of this approach. Through a cooperative agreement between Hopkins and MCWD both partners outlined social, economic and environmental goals for a previously hidden, one acre park which was once the highest crime response location in the City. Working together nearly 5 acres of parkland which now connects to a restored streambank of Minnehaha Creek provides needed parkland in a heavily urbanized area of the City. The park incorporates over 25 acres of regional stormwater treatment under new greenspace which will off-set regulatory requirements for a planned affordable housing project.

The project creates a 20,000 ft3 underground iron enhanced sand filtration system which maximizes green space. The work also provides creek buffer restoration, creek access, educational signage, community garden, walking paths, and playgrounds.

Completed in September of 2015 the park now serves as a community amenity which brings together the neighborhood while improving the water which flows through it.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track C: Planning Sustainable Practices *(continued)*

SWLRT - Regulatory Complexity

Jim Alexander (jim.alexander@metrotransit.org), Southwest LRT Project Office; Earth Evans, WSB and Associates; Brady Busselman, Sambatek; Charlie Howley, Hansen Thorp Pellinen Olson, Inc

This presentation will provide a summary of the water resources regulatory complexity, outreach and collaboration with local jurisdictions that guided the design of the Southwest Light Rail Transit. The 14.5 linear project corridor required early and ongoing coordination with permitting agencies to define rule applicability. The design process occurred simultaneously with changing regulatory requirements including implementation of NOAA Atlas 14 precipitation and MIDS, which had a significant impact on the design, midway through the project. The presentation will also provide an overview of the proposed stormwater BMPs for the project and lessons learned related to application of layers of regulatory requirements to a large and complex project.

Embracing Sustainable Stormwater Management at the University of Minnesota

Erin Hunker (ehunker@srfconsulting.com), SRF Consulting Group; Cathy Abene, University of Minnesota

Pleasant Street is the gateway to the East Bank campus of the University of Minnesota. The corridor was reconstructed to improve safety and efficiency of traffic flow in this busy public access point for pedestrians, bicyclists, and vehicles. The University viewed this project as an opportunity to improve stormwater runoff to incorporate a sustainable stormwater management system that treats stormwater close to the source. The University and SRF developed stormwater management goals for the project that included reducing runoff rates, providing volume retention, and removing total suspended solids and total phosphorus.

The stormwater management system consists of green infrastructure BMPs, including tree trenches, permeable pavement, and a bioretention basin. The system integrates BMPs with the landscaping plans for the corridor. The bioretention basin receives runoff through an underground distribution system that provides volume retention and storage up to the 100-year storm event. Detailed XP-SWMM modeling was completed to maximize the storage within the system and provide the greatest amount of rate control. The stormwater management system design meets the stormwater volume goal of retaining the runoff from the 1.1-inch event over the impervious surface area and removing 80% of the post development TSS and 60% of the post development TP.

This presentation will cover the design, hydrologic and hydraulic modeling, construction, and costs of the project.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track D: N & P Measuring, Monitoring, Modeling, and Management

Availability of Phosphorus in Sediment from Lake Superior and its Watershed

Tayler Hebner (hebne006@d.umn.edu), Gustavo Merten, Ajan Ajanic, Elizabeth Hill, Sandra Brovold, and Robert W. Sterner, University of Minnesota Duluth

Phosphorus is a limiting nutrient used for growth of primary producers in lakes and rivers. In Lake Superior, sediment plays an important role in the dynamics of phosphorus levels. Depending upon the geochemical compartments of the sediment that phosphorus is found in, the sediment could be either a sink or source of phosphorus for Lake Superior. As phosphorus-containing lake sediment is circulated within the lake by means of shore erosion and resuspension, phosphorus can be either released or absorbed by the sediment. The amount of the total phosphorus contained in the sediment that is readily released is dependent upon the compartment it is associated with. The distribution of phosphorus in different geochemical compartments in Lake Superior sediments has not been previously investigated. In this study, sediment samples were collected from sources in the Lake Superior region including river tributaries, shore erosion, and bottom lake sediment. A sequence of chemical reactions was performed to extract phosphorus from different geochemical compartments. A series of five sequential reactions provided information regarding loosely-bound, iron-bound, aluminum-bound, labile organic, and mineral-bound phosphorus. In this order, the fractions of phosphorus were extracted from least to most tightly bound. We found that mineral-bound phosphorus was the most abundant form. This was followed by aluminum-bound, labile organic, and iron-bound. The least abundant form was loosely-bound phosphorus. The geochemical distribution of phosphorus that we observed indicates that it is tightly bound to incoming lake sediments, raising questions about whether these sediments can be considered sinks or sources of phosphorus.

Measuring and Modeling Phosphorus Loss and Transport in the LeSueur River Basin

Brent Dalzell (bdalzell@umn.edu), Department of Soil, Water, and Climate, University of Minnesota; Jacques Finlay, Amy Hansen and Christy Dolph, University of Minnesota

We are conducting a combined field- and model-based approach to quantify the sources of phosphorus in the LeSueur River Basin as well as understand the mechanisms responsible for its transport from the landscape into streams and rivers. Field sampling at multiple locations within the watershed is being conducted to quantify spatial variability within the watershed and identify the potential role that wetlands may play in determining in-stream phosphorus levels. These field data are being used to parameterize and validate and watershed scale SWAT model of the Basin. Wetlands are represented in the model based on generalized size-volume characteristics that are based on prairie pothole wetlands typical for the region. Preliminary model results show very good model performance for daily hydrology and crop growth; work on sediment and nutrient calibration is ongoing. I will present model-based estimates for edge-of-field losses of sediment and nutrients in the LeSueur River Basin and compare those loading rates against area-normalized fluxes observed in the stream network. I will also discuss the challenges associated with modeling sediment and nutrient export in the Minnesota River Basin, where failing streambanks and bluffs can be the dominant sources of sediment and phosphorus. Differentiating between different sources and mechanisms of nutrient export will be critical for designing and implementing successful mitigation strategies to work towards water quality goals.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track D: N & P Measuring, Monitoring, Modeling, and Management *(continued)*

Overview of the Nitrogen Fertilizer Rule

Katie Wolf (katie.wolf@state.mn.us), Annie Felix-Gerth and Larry Gunderson, Minnesota Department of Agriculture

Nitrate can be a significant concern in areas with vulnerable groundwater in Minnesota. The Minnesota Department of Agriculture (MDA) is developing a Nitrogen Fertilizer Rule that will apply in areas impacted by elevated nitrate levels in the water supply or with vulnerable aquifers. The presentation will focus on the proposed rule, the rulemaking process and key elements of the Nitrogen Fertilizer Management Plan (NFMP) that are currently being implemented by the MDA.

The MDA received the authority to adopt the rule under the Groundwater Protection Act. The Nitrogen Fertilizer Rule will be based on the processes to reduce nitrate from fertilizer in groundwater as outlined in the NFMP. The rule will enable the MDA to regulate nitrogen fertilizer use to protect groundwater.

The rule will contain two parts. Part 1 will restrict application of nitrogen fertilizer in the fall and to frozen soils in vulnerable groundwater areas. Part 2 will use a Commissioner's Order to specify requirements that must be followed in areas with high nitrate. Restrictions will vary for different regions and soil types and will be based on the nitrogen best management practices developed by the University of Minnesota and adopted by the MDA.

Evaluating Nitrogen Management and Crop Yield Through On-Farm Field Trial Demonstrations

Spencer Herbert (spencer.herbert@state.mn.us), Margaret Wagner, Ryan Lemickson, Dawn Bernau and Aaron Janz, Minnesota Department of Agriculture

Nitrate concentrations in surface and ground water are of concern for both water quality and health reasons. Nitrogen fertilizer use in agricultural production is one source of this nitrate. To help farmers manage their nitrogen fertilizer in an environmentally responsible and economically feasible way, the Minnesota Department of Agriculture developed and installed the Nutrient Management Initiative (NMI). The NMI encourages farmers and their crop advisers to install field trials on their farms, applying nitrogen management practices specific to their individual farming operations. Results allow them to evaluate new or alternative nitrogen management strategies including changes in nitrogen rate, application timing, nitrogen source, or use of a stabilizing product. Detailed agronomic and economic information is gathered to evaluate an alternative practice chosen by the farmer. Results including crop yield, nitrogen use efficiency, and economic return on investment are measured. In 2015, there were 166 NMI field trial plots throughout Minnesota, with a majority located in the southeast and south-central regions; 58 plots consisted of replicated treatments allowing statistical analyses. Results suggest that for many producers, slight reductions in nitrogen application rates will not impact yield but may provide an overall benefit to the environment. Split nitrogen application trials showed the potential to increase crop yield while benefitting water quality. Results were summarized by University of Minnesota Extension nitrogen best management practice region and compiled into a comprehensive result publication. The NMI is continuing in 2016, with the anticipation that producers and their advisers will continue to consider alternative nutrient management practices.

Luncheon Presentation 12:15 p.m. – 1:00 p.m.

Federal/State Partnerships in Atomospheric and Coastal Research

Craig McLean, Assistant Administrator, Oceanic and Atmospheric Research, National Oceanic, and Atmospheric Administration, United States Department of Commerce

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track A: Social Science Applications in Conservation and Citizen Education

Building Soil and Water Conservation District staff capacity for groundwater protection

Amit Pradhananga (prad0047@umn.edu), University of Minnesota; Sharon Pfeifer, Minnesota Department of Natural Resources: Mae A Davenport, Department of Forest Resources, University of Minnesota

The success of state- level clean water initiatives depends heavily on local government participation. For this reason, in 2015, the Minnesota Department of Natural Resources, Minnesota Association of Soil and Water Conservation Districts, and University of Minnesota researchers conducted the first ever statewide survey of Minnesota's Soil and Water Conservation District (SWCD) staff to better understand their capacity to address local groundwater quality and quantity issues. Data were collected using an online survey to assess SWCD staff knowledge and capacity to protect groundwater. The survey findings were used to design tailored workshops for SWCD staff that were offered in 7 locations around the state in 2015-2016. The project used the Social Measures Monitoring System, a comprehensive social science model, to design the survey and to evaluate workshop success. Survey results from 187 SWCD staff revealed gaps in knowledge and local capacity in groundwater protection. Workshop evaluation was built into the project design and the tailored workshops were analyzed using pre- and post-workshop surveys to measure perceived changes in acquired groundwater knowledge. Workshop analysis revealed statistically significant improvements in groundwater knowledge and in individual confidence to talk to landowners about groundwater issues. Study findings will inform statewide planning efforts and SWCD capacity building programs related to groundwater protection.

Using Social Science to Accelerate Conservation

Peggy Knapp (pknapp@freshwater.org), Freshwater Society

Outreach, education and community engagement are not just boxes one checks off on a form. If only three people showed up for the hearing, it is time to rethink how social science can help you stretch project dollars and broaden the impact of projects. Minnesota spends millions each year digging holes and moving dirt for cleaner water. Yet typical dirt moving projects rarely make significant use of the "soft sciences" to leverage the attention projects attract and make beneficial behavioral ripple effects in their community.

Social science research can give organizations greater insight into what motivates people to adopt conservation behaviors, and the barriers that constrain adoption. Knowing, however, does not necessarily translate into doing. How can organizations respond to social science research with programs and resources that meet the needs of communities, build capacity, and inspire people to do more?

This presentation will highlight several recent qualitative studies that articulate community needs, explore organizational responses to state policy, and uncover systemic barriers that inhibit broader landowner participation in conservation efforts. These recent studies use surveys, interviews, World Cafe-style dialogues and other qualitative methods to gather qualitative data. The presentation then offers processes that demonstrate not only the value of social science research, but how to use research as the basis for motivating action.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track A: Social Science Applications in Conservation and Citizen Education *(continued)*

Inspiring Elected and Appointed Community Leaders to Take Action Accomplished Through Education and Training; How Workshops-on-the-Water Build Knowledge and Result in Action and Behavior Changes

John Bilotta (jbilotta@umn.edu), University of Minnesota Extension & Sea Grant Program

This presentation will provide results, insights and experiences about how multiple years of NEMO (Nonpoint Education for Municipal Officials) workshops-on-the-water (WOW) have been effective over time. Results from more than six years of success and impact from WOW programs on the St. Croix River will be presented that include comprehensive evaluation results from the more than 600 leaders who have participated representing more than ten watersheds across five counties in both Minnesota and Wisconsin. Additional data and results from programs on Lake Minnetonka and the Mississippi River will also be included. This presentation will include the results of program evaluation and assessment accomplished through multiple methods of assessment and will include summaries of both quantitative and qualitative data. The presentation will feature the innovative approaches of these highly interactive education programs and will highlight the knowledge and skills gained and actions taken by leaders over the years as a result of participating. In addition, the presentation will highlight how these hands-on, in-person programs provide an effective forum and form of engagement between community and watershed leaders and professionals. Highlights of the results include the following: 75% of participants (2010) indicated a significant increase in their level of understanding about monitoring and how water quality data is gathered in used. 43% of participants (2011) had both participated in the workshops in prior years and taken an action as a result. 79% (2013) of participants indicated that their learning experience was significantly enhanced by being on the River for the workshop. Quantitative data such as this combined with qualitative information (interviews, videos, and written assessments) have been combined and show that WOW programs have significant impact on increasing the knowledge of local leaders and leads them towards taking action.

Conservation Leverage Points in Rural Minnesota: Learning from Citizens in the Watonwan River Watershed

Dustin Anderson (dustin.anderson@windomnet.com), Greater Blue Earth River Basin Alliance; Kimberly Musser, Water Resources Center, Minnesota State University, Mankato; Paul Davis, Minnesota Pollution Control Agency

The Minnesota Pollution Control Agency is developing Watershed Restoration and Protection Strategies (WRAPS) for the agriculturally-dominated Watonwan River Watershed located in south-central Minnesota. Capturing local citizen opinions on land management and water resources is important to identifying the specific restoration and protection strategies that could realistically be implemented in the Watonwan Watershed to reduce pollutant loads. This local consultative process with landowners will help clarify BMPs that have greater appeal to watershed residents and higher potential for adoption.

One-on-one interviews with watershed residents were conducted to understand the importance of local water resources to the community, to document local concerns over water quality and quantity, and to identify the barriers to implementing agriculture best management practices (BMP) on the landscape. Interviews were audio-recorded, transcribed to text, and analyzed to garner major themes and trends. Citizen concerns include dwindling communities, property tax burden, inter-farmer competition, and burgeoning farm size. Water resources are valued for both recreation and drainage and concerns over water resources varied by geography, including concerns over groundwater quantity, greening lakes, widening rivers, and surface runoff from farm fields. Economic and operational feasibility has emerged as the greatest barrier to BMP implementation; farmers are generally not willing to change their operation or invest funds in conservation practices without tangible benefits.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track B: Climate Change Impacts

Projected Impacts of Climate and Forest Change on Lake Superior Hydrology and Biology

William (Bill) Herb (herb0003@umn.edu), St. Anthony Falls Lab, University of Minnesota; Kristen Blann, The Nature Conservancy; Lucinda Johnson, Center for Water and the Environment, Natural Resources Research Institute, UMN-Duluth; Will Bartsch, Environmental Protection Agency, Midcontinent Ecology Division; Meijun Cai, Natural Resources Research Institute, UMN-Duluth

The combination of climate and land use change threatens to significantly alter freshwater ecosystems, functions, and services in Minnesota's Lake Superior North Shore region. These alterations represent significant risks and impacts to local communities, dependent on a tourism-based economy. This project explored future response of streams to climate and land use change to aid land and water use planning, stream management and restoration, and climate adaptation. We developed hydrologic models to characterize current conditions, and to explore how North Shore streams may respond to future climate and land cover scenarios. From the models, we derived flow metrics hypothesized to be ecologically relevant, and attempted to identify critical stream flow parameters for maintaining good habitat for native fish species such as brook trout. Flow metrics by themselves were significant, but poor predictors of stream fish assemblages. Flow responses were generally more sensitive to climate than land cover changes, but both can drive significant flow changes, especially on a seasonal basis. Warmer, drier climate scenarios, in conjunction with increased conifer fraction, generally led to modelled increases in evapotranspiration of up to 50% and corresponding reductions in mean annual flow (28%) and summer low flow (90%). Conversely, wetter climate scenarios may drive increased flashiness, high flow magnitude and frequency, with ecological impacts dependent on timing. Results are being used to drive discussions with local and regional decisionmakers about management strategies for maintaining and enhancing stream resilience, in the face of significant uncertainty.

Examining Community Resilience in Extreme Climatic Conditions

Rebecca Teasley (rteasley@d.umn.edu), University of Minnesota Duluth; Karlyn Eckman, University of Minnesota; Courtney Kowalczak, Environmental Institute Director, Fond du Lac Tribal & Community College; Dawn Newman, American Indian and Tribal Partnership Liaison, Minnesota Extension; Tashi Gulrung, Sea Grant Graduate

This project examined factors contributing to resiliency demonstrated by two communities severely impacted by the 2012 flooding in the St. Louis River Basin. On June 30, 2012, the basin experienced an extreme annual exceedance probability (AEP) for worst case 24-hour rainfall. This flood caused more than $100 million in civil infrastructure damage in fifteen counties and the Fond du Lac tribal nation. This project focused on two communities: the Fond du Lac tribal community of Ojibwe; and Fond du Lac village, the small non-tribal town located southwest of Duluth. Both communities exhibited strong internal social bonds, mutual assistance, and informal yet effective communication. This spontaneous local resilience and community bonding, despite the challenges of extreme hardship and isolation caused by infrastructure failure, is the focus of this research. The research goals include three areas: community resilience, communication, and civil engineering. Widespread damage to engineering lifelines took place, isolating communities and destroying normal means of communication. While the two communities experienced unprecedented disaster, strong underlying community bonds contributed to resiliency and recovery. Actions and communication patterns previously un-documented during the flood, hold promise for positive learning examples. A mixed methods approach combining engineering and social science research (engineering interviews; key informant interviews; listening sessions with tribal and local communities; oral histories; and a KAP (knowledge, attitudes and practices) study). The KAP study and interviews inform a guide to making recommendations to the communities to dealing with extreme floods in the future. This project will be completed this in July 2016.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track B: Climate Change Impacts *(continued)*

Downscaled Climate Change Data Acquisition

Brian Alberto (Brian.T.Alberto@usace.army.mil), Pat Foley and Ann Banitt, United States Army Corps of Engineers

The current state of climate modeling has produced a number of data sets for one to use when quantifying the effects of climate change for a particular geographic area or region. As a result, it's difficult to identify what data sets are publically available and why some data sets are more specific to certain regions.

This presentation will showcase one publically available dataset which can be leveraged for climate analysis in the upper Midwest and across the continental United States. Coupled Model Intercomparison Project Phase 3, or CMIP3, is a climate dataset that provides monthly temperature and precipitation data to estimate future climate trends based on three different future carbon emission scenarios (low, medium, and high). The presentation will examine what data is available to users, how the data is generated, how the data can be downloaded from the website, as well as the format in which the data can be acquired.

It should be noted that a subsequent presentation submitted to this conference, titled A Case Study for Climate Change in Fargo, ND Using Bias Corrected Spatially Disaggregated (BCSD) Data uses this CMIP3 dataset to examine the effects of climate change at Fargo, ND.

Additional Notes: The USACE is submitting three abstracts related to Climate Change Impacts and Hydrologic Analysis:

(1) Downscaled Climate Change Data Acquisition (Presenter: Brian Alberto)

(2) Incorporation of Climate Change Impacts into Hydrologic Analysis (Presenter: Chanel Mueller)

(3) Case Study for Climate Change in Fargo, ND Using Bias Corrected Spatially Disaggregated (BCSD) Data (Presenter: Brian Alberto)

If possible, we would like to request that if more than one abstract is selected for inclusion within the conference that their associated presentations be included in one session, consecutively, in the order listed above. This will enable my colleagues and me to provide context for one another's presentations and to prevent redundancy. Thank you for your consideration.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track B: Climate Change Impacts *(continued)*

Case Study for Climate Change in Fargo, ND Using Bias Corrected Spatially Disaggregated (BCSD) Data

Brian Alberto (Brian.T.Alberto@usace.army.mil), Pat Foley and Ann Banitt, United States Army Corps of Engineers

The purpose of this presentation is to apply a methodology used by the Bureau of Reclamation to quantify the impacts and uncertainty of climate change on stream flows. This peer-reviewed methodology used 112 sets of publicly available monthly Coupled Model Intercomparison Project phase 3 (CMIP3) bias-corrected spatially disaggregated (BCSD) precipitation and temperature data to generate annual peak flow frequency curves for the 1950-1999 base period as well for three future time periods, 2011-2040, 2041-2070, and 2071-2099. BCSD data was analyzed to create a record of monthly temperature and precipitation values for each of the three time periods. Weather generations were applied to the temperature and precipitation data to add variability to the dataset and develop daily data. Hydrologic models were run to create a flow record from which flow frequency curves and their uncertainty could be generated for each of the three future time periods.

Results of this analysis suggest likely median increases in the size of all frequency floods for all three time periods with respect to the base period. Later time periods (2041-2070, and 2071-2099) showed smaller increases than the first time period (2011-2040), which is thought to be a result of rising temperatures, which would effectively reduce accumulated snow water equivalent in the basin. It should also be noted that some of the climate projections/weather generations showed a reduction in flow frequency values for all future time periods, which illustrates the uncertainty that's associated with the current state of climate modeling.

Additional Notes: USACE is submitting 3 abstracts related to Climate Change and kindly request these presentations be coupled together into one session

1) Downscaled Climate Change Data Acquisition -Alberto

2) Incorporation of Climate Change Impacts into Hydrologic Analysis- Mueller

3) Case Study for Climate Change in Fargo, ND Using Bias Corrected Spatially Disaggregated (BCSD) Data- Alber

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track B: Climate Change Impacts *(continued)*

Incorporation of Climate Change Impacts into Hydrologic Analysis

Chanel Mueller (Chanel.Mueller@usace.army.mil) and Bryan Baker, United States Army Corps of Engineers

Scientific evidence shows that in some places, certain variables critical to the design and evaluation of water resources projects are being impacted by climate change and anthropogenic watershed modifications in a way that is undermining the fundamental assumption of stationarity typically applied in accepted hydrologic design practices. To start to address how water resources engineers can incorporate techniques that account for non-stationary hydro-meteorological records into analyses, the U.S Army Corps of Engineers (USACE) has recently released revised technical guidance related to the identification of both observed changes, as well as potential future changes in hydro-climatic conditions. In addition to the written guidance, the USACE has developed two web applications that will make it easier for water resources professionals to both obtain and apply the techniques described in the guidance in a technically correct, timely and reproducible manner.

This presentation will focus on an overview of USACE policy regarding the incorporation of climate change impacts into hydrologic analysis and will provide an in-depth description of the recently released Guidance for Detection of Nonstationarities in Annual Maximum Discharges and the Engineering and Construction Bulletin describing Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects. The presentation will be focused on providing the audience with exposure to how to apply the guidance and associated web applications to engineering applications like flow-frequency analysis.

Additional Notes: The USACE is submitting three abstracts related to Climate Change Impacts and Hydrologic Analysis:

(1) Downscaled Climate Change Data Acquisition (Presenter: Brian Alberto)

(2) Incorporation of Climate Change Impacts into Hydrologic Analysis (Presenter: Chanel Mueller)

(3) Case Study for Climate Change in Fargo, ND Using Bias Corrected Spa

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track C: BMPs for Urban Retrofits

Building an Urban Stormwater Treatment Testbed

Marcy Bean (mbean@mwmo.org) and Doug Snyder, Mississippi Watershed Management Organization; William Alms, WSB & Associates

The St. Anthony Regional Stormwater Treatment and Research System uses a combination of technologies to treat a 600-acre subwatershed near the border of the Minneapolis and St. Anthony Village. With water quality monitoring in the forefront of project goals, the system was designed to allow researchers to easily plug in new and emerging treatment technologies to test their effectiveness in removing pollution from stormwater runoff in this highly urbanized area.

Through the collaboration of multiple organizations, the facility will allow for multi-node monitoring of water quality, evaluation of treatment technologies, and effectiveness of maintenance regimes for underground treatment systems. The facility, which will be fully operational in summer of 2016, is initially outfitted with a Contech Vortechs swirl chamber system for primary treatment and a dual chamber secondary system including both an iron-enhanced sandbed and Contech StormFilter cartridges filled with Phosphosorb. This setup is projected to remove an estimated annual average of 39 tons of total suspended solids and 176 pounds of total phosphorus.

This presentation will cover lessons learned during design and construction, project costs, discussion of treatment technologies in use, and a brief overview of the objectives of the water quality monitoring system.

Irrigate, Infiltrate, Automate: Stormwater Reuse at Upper Villa Park

Forrest Kelley (forrest@capitolregionwd.org), Capitol Region Watershed District

Capitol Region Watershed District (CRWD) and the City of Roseville, through two State grants, constructed a 60,000 cubic foot underground stormwater infiltration system combined with a 13,000 cubic foot modular concrete cistern to harvest and use stormwater for irrigation of a high-use softball field at Upper Villa Park in Roseville, MN. The project protects Lake McCarrons, a high quality recreational lake within the urban core of the Twin Cities, and the Villa Park Wetland System by capturing stormwater runoff and filtering the pollutants associated with urban stormwater.

In addition to removing approximately 45 pounds of TP annually, the system will save up to 1.3 million gallons of drinking water by capturing and using rainwater to irrigate the softball field. The system uses real time technology to actively manage the water level in the cistern. Prior to a rain storm, software programmed to communicate with weather forecasts and level sensors within the rainwater cistern open an automated valve to drain the cistern into the underground infiltration pipes and capture more stormwater. The valve closes after the storm and fills the cistern to provide irrigation for the softball field.

To determine effectiveness of infiltration practice pollutant removal, three pan-lysimeter wells were installed at depths of 3, 5, and 7 feet below the perforated pipes. Samples will be extracted from the wells and tested to determine the fate of pollutants once they leave the infiltration system

Construction was substantially complete April, 2016. A full season of monitoring data will be obtained for presentation.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track C: BMPs for Urban Retrofits *(continued)*

Tree Trench and Permeable Pavers in the Edison High School Parking Lot

Dan Edgerton (dan.edgerton@stantec.com) and Mark Statz, Stantec

A case study of the Minneapolis Edison High School Parking Lot LID Stormwater Improvements will be presented. The goals of the project, completed in summer 2013, were to: (1) Improve the water quality of stormwater that previously drained untreated to the Mississippi River; (2) Provide educational opportunities for Edison High School students; (3) Inform and engage the Holland Neighborhood about sustainable stormwater management; and (4) Promote collaboration of stormwater management among Minneapolis Public Schools, Public Works, and Parks and Recreation Board.

The project involves the planning, design, construction, and monitoring of a tree trench and permeable pavers to capture, treat, and infiltrate runoff from the parking lot. Construction was fast-tracked in the summer in order to avoid disruption during the academic year. Stormwater monitoring has been occurring since summer 2014. A variety of approaches were evaluated to demonstrate stormwater techniques to students and neighbors. Science teachers at Edison High School have been using the project to incorporate stormwater into their IB curriculum. Funding was provided by the Mississippi WMO.

The presentation will summarize the design considerations, illustrate construction activities and lessons learned, provide tree trench monitoring results, and discuss collaboration and educational opportunities.

Sustainable Stormwater Analysis for the Ford Site Redevelopment, St. Paul, MN

Robert Fossum (bob@capitolregionwd.org), Capitol Region Watershed Distric; Wes Saunders-Pearce, City of St. Paul

Ford's former Twin Cities Assembly Plant in St. Paul is in the process of being redeveloped over the coming years on more than 135 acres of land situated along the Mississippi River. The City of St. Paul's vision for the site is that it will be a livable, mixed-use neighborhood that looks to the future a high quality design for energy, buildings and infrastructure.

Capitol Region Watershed District and the City of Saint Paul collaborated to develop a stormwater management vision for Ford Site that will guide the City's Master Plan for the site. A comparative analysis approach was completed to compare redevelopment public realm alternatives. A centralized stormwater management approach which would include a surface water feature that is community amenity was compared to a baseline parcel-by-parcel approach. Innovative approaches/tools for comparing feasibility costs, benefits, impacts and sustainability profiles for the different options has provided valuable insights about the community value that redevelopment alternatives might generate. A key component of the proposed analysis was monetization of ALL of the costs and benefits of each scenario. Sustainable Return on Investment (SROI) analysis using the software AutoCase allowed for monetizing of the estimated environmental and social impacts of each alternative. Attendees to this talk will see how stakeholders were able to answer the following key questions relative to planning at the Ford Site:

Will the 21st Century Community water feature approach cost more than normal?

How will we quantify social benefits of added livability?

Can we financially measure our environmental impact?

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track D: Groundwater and Surface Water Interactions

Estimating Groundwater Recharge to Buried Aquifers

Alyssa Witt (witta@iastate,edu), Jared Trost, and James Stark, United States Geological Survey; William Simpkins, Iowa State University

Buried aquifers in glacial sediments provide drinking water to thousands of Minnesota residents. However, water-resource planning is impeded by the lack of recharge information through overlying confining beds. The U.S. Geological Survey, Minnesota Water Science Center, in cooperation with Iowa State University, the Minnesota Departments of Health and Natural Resources, and the Minnesota Geological Survey are characterizing hydraulic and geochemical properties of glacial confining beds at two sites to estimate recharge to buried aquifers. One site is in the Des Moines Lobe, in Litchfield, and the second is in the Superior Lobe, in Cromwell. Nineteen piezometers were installed in four nests. Hydraulic heads were measured and estimates of till hydraulic conductivity were made to calculate vertical recharge to underlying aquifers. Concentrations of chloride (Cl) and bromide (Br), and stable isotopes (18O, 2H) were analyzed to estimate the age of water in confining beds. At the Des Moines Lobe site, downward vertical hydraulic gradients occur in the confining bed. At the Superior Lobe site, hydraulic gradients suggest an upward flow. Results for Î´ 18O and Î´ 2H did not show older glacial pore water with depth at either site. This project is supported by funding from Minnesota Legislative and Citizens Commission on Minnesota Resources (LCCMR) and by the U.S. Geological Survey.

Characterizing Groundwater and Surface-Water Interactions in Selected Northeastern Twin Cities Lakes, Minnesota - Part 1: Statistical Analysis and Field Data Collection

Perry Jones (pmjones@usgs.gov), Jared Trost, Donald O. Rosenberry, Aliesha Diekoff and Daniel Morel, U.S. Geological Survey

The U.S. Geological Survey (USGS), Metropolitan Council of the Twin Cities, and the Minnesota Department of Health conducted a cooperative study to assess groundwater and surface-water interactions in northeast Twin Cities Metropolitan Area (TCMA) lakes. This study builds on a 2013 study focused on White Bear Lake (http://pubs.usgs.gov/sir/2013/5044/).

This talk presents results of Part 1 of the northeast TCMA study focused on 1) statistical analyses of lake-level relations using existing climatic, hydrologic, land cover, and geologic data, and 2) field hydrologic and geologic data collection to support a groundwater-flow modeling effort. The statistical analyses were done to assess lake and watershed characteristics that explain differences in lake-level fluctuations in 96 northeast TCMA lakes during the period 2002-2010 and long-term relations (1925-2014) between lake levels and climate in a subset of northeast TCMA lakes.

Field data collection efforts focused on characterizing water-quality, lake-sediment lithology, and groundwater levels and flows. Water samples from wells were analyzed for stable isotope (oxygen, hydrogen), sulfur hexafluoride (SF6), and chlorofluorocarbons (CFC) to estimate surface-water contributions to the wells and age-date the water in the wells. Lake-sediment cores were collected from White Bear Lake and continuous seismic-reflection profiles were taken in six lakes to characterize lake-sediment lithology and structure. Water levels were measured in piezometers installed in deeper parts of White Bear Lake to assess groundwater and lake water interactions. Seepage measurements were made in White Bear Lake to assess groundwater flow in the deeper sections of the lake.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track D: Groundwater and Surface Water Interactions *(continued)*

Characterizing Groundwater and Surface-Water Interactions in Selected Northeastern Twin Cities Lakes, Minnesota- Part 2: Groundwater Flow Model

Jason Roth (jroth@usgs.gov), Perry Jones and Catherine Christenson, U.S. Geological Survey

A cooperative study was conducted by the U.S. Geological Survey (USGS), Metropolitan Council, and the Minnesota Department of Health to assess groundwater and surface-water interactions in northeast Twin Cities Metropolitan Area (TCMA) lakes. The study builds on cooperative work assessing groundwater and surface-water interactions around White Bear Lake (http://pubs.usgs.gov/sir/2013/5044/). As part of this study, a finite-difference, groundwater-flow model was constructed to assess groundwater and surface-water interactions and the effects of groundwater withdrawals on lake levels. The model also can be used to assess lake-level-augmentation, climate-change, and land-use changes scenarios on lake-water budgets.

The groundwater-flow model was built from the Metropolitan Council's Metro Model 3, which uses USGS MODFLOW model. Refinements made to Metro Model 3 included increasing grid-cell resolution, providing more detail to the Quaternary geology in the model layering, and updating groundwater pumping data. Output from a spatially distributed temporal recharge model (SWB model) was used to improve the recharge simulation in the model. The Lake package (LAK3) of MODFLOW was used to explicitly model water budgets in selected lakes across the northeast TCMA. This presentation will describe the concepts of groundwater-flow model, compare water budgets for the simulated lakes using LAK3, highlight lake level changes in selected lakes, and provide other key results of transient model simulations under selected high- and low-stress groundwater pumping scenarios.

Water Budget Changes from Wetland and Prairie Restoration, Glacial Ridge National Wildlife Refuge, Northwestern Minnesota, 2006-13

Tim Cowdery (cowdery@usgs.gov) and Catherine Christenson, U.S. Geological Survey

Annual groundwater and surface-water budgets were calculated for two years to quantify changes in water flow resulting from wetlands and prairies that were restored during the 2000's over 41,500 acres of the Glacial Ridge National Wildlife Refuge, near Crookston in northwestern Minnesota. Groundwater and surface waters at Glacial Ridge form one hydrologic system composed principally of long, narrow sandy upland beach ridges of Glacial Lake Agassiz and inter-beach wetlands. Restorations consisted of completely removing ditches dug for agricultural drainage in the early 20th century and replanting native vegetation. Surficial aquifers and streamflow responded quickly to changes in precipitation.

The most comparable pre- and post-restoration annual water budgets are from 2006 (pre) and 2013 (post) because these years had similar total rainfall and a similar distribution across the year. Comparison of these years shows a 36 percent increase in groundwater recharge (from 11 percent to 15 percent of total precipitation (TP)) and a 20 percent decrease in groundwater discharge to ditches (5 percent to 4 percent). Total water leaving the study area through ditches decreased 45 percent (22 percent to 12 percent TP). These hydrologic changes were balanced by a 7 percent increase in unmeasured losses (72 percent to 77 percent TP), which represent primarily evapotranspiration from the land surface and from closed-basin wetlands. Study results demonstrate that wetland and prairie restoration have a major effect on water budgets by reducing water flowing from the study area by nearly half and transferring it to evapotranspiration.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track A: Community Engagement and Perspectives

The 2016 State of the River Report

Trevor Russell (trussell@fmr.org), Friends of the Mississippi River; Lark Weller, National Park Service - Mississippi National River and Recreation Area

How is the health of the Mississippi River in the twin cities? Can I safely swim in it? Is water pollution improving? Can I eat the fish I catch? What can we do about Asian carp?

Friends of the Mississippi River and the National Park Service have teamed up to publish the second edition of the award-winning "State of the River Report." The report details the status and trends of 12 key indicators of river health, highlighting the swimming, fishing, aquatic life and emerging contamination issues facing the river--as well as priority solutions for each. This edition of the report is due to be published September 22nd 2016.

The Easement Experience

Michael Lynn (michael.lynn@co.dakota.mn.us) and Alan Singer, Dakota County

Dakota County is an ecologically diverse, river-rich metro county with over 410,000 residents and limited County land-use authority. In 2002 residents passed a $20 million bond referendum to permanently protect farmland and natural areas with a priority goal of protecting water quality. Although the County has worked with other public entities to protect land and water, the County has been actively using conservation easements as a tool for protecting surface water. Since 2003, the County has acquired 112 conservation easements on private lands totaling 9,275 acres protecting 142 miles of shoreland. Agricultural easements require a 150-foot wide, permanently vegetated buffer along rivers and streams. Natural area easements include the development of a Natural Resource Management Plan (NRMP), which analyze a property's landscape context, physical conditions, hydrology, vegetation, land management, wildlife, and develops a voluntary work plan for restoration.

This presentation will provide an overview and lessons from the County's award winning land conservation program and use actual acquisition examples to illustrate both the opportunities and practical challenges of working with private landowners to protect water quality across a dynamic suburban and rural landscape. Topics will include: project design, land valuation, ecological vs. economic value, landowner's expectations, easement requirements, title and legal boundary issues, environmental clean-up, mortgage subordination and landowner bankruptcy, and private landowner commitment to natural resource restoration.

We Think We Can? Collective Efficacy and Community Perspectives on Climate, Extreme Weather, and Water Management in Minnesota's Lake Superior Basin

Vanessa Perry (perry497@umn.edu) and Mae Davenport, University of Minnesota Twin Cities; George Host, University of Minnesota Duluth

This study examined a Great Lakes coastal community's capacity to adapt to climate and extreme weather-related impacts. Data were gathered through 27 in-depth interviews with decision makers, natural resource professionals, and other community leaders in the Mission Creek and Miller Creek subwatersheds of the Lake Superior basin. In collaboration with the Natural Resource Research Institute (NRRI) at University of Minnesota Duluth, we investigated beliefs about climate and extreme weather, perceptions of local impacts, and reflections on community preparedness. Findings indicate that though the communities have many high capacity traits for collective natural resource management and response, divergence exists among key community actors about the need and capacity for adaptation to environmental changes including climate change, extreme weather, and water resource-related impacts. Among participants who perceived a need to build adaptive capacity, there was little convergence on priority strategies or actions. Without a shared problem definition or clarity in action priorities, community members' sense of self-efficacy and collective efficacy is constrained. Feeling helpless or stuck in an untenable situation can impede adaptation. This study provides a framework for understanding and building capacity for adaptation and examines the role of collective efficacy. Final reporting for the study will be completed 2016.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track A: Community Engagement and Perspectives *(continued)*

Using the Agricultural Conservation Planning Framework to Analyze Minnesota Watersheds

Ann Lewandowski (alewand@umn.edu) and Les Everett, University of Minnesota Water Resources Center

Achieving measurable water quality improvements requires siting the right practices in the right locations, and integrating efforts across a watershed. Developing locally appropriate solutions requires landowner engagement and leadership. The Agricultural Conservation Planning Framework (ACPF) helps with both watershed-based siting of practices and engaging landowners. The ACPF is an ArcGIS-based tool developed by the USDA Agricultural Research Service in Iowa and is being used across the upper Midwest. The objectives of this project were to evaluate the potential for use of the ACPF in Minnesota, and provide information to local conservationists who are considering using the ACPF. In May and August 2015, we trained 39 local GIS technicians in use of the ACPF. The following spring, we interviewed a few of the trainees to gather detailed feedback on their experience using the tool. Respondents said the tools were easy and quick to run, but only after the required hydro-modification of the DEM, which is very time consuming. After hydro-modification, a HUC 12-sized watershed requires four-to-eight hours to analyze. The lack of the full ArcGIS license is a major barrier to use of the ACPF in many local jurisdictions. It is important ACPF analyses be run by people familiar with the local landscape. Additional feedback from ACPF users will be discussed.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track B: Modeling and Managing Nutrient and Thermal Drivers of Aquatic Habitat

Using Predictive Lake Modeling to Assess the Development of Cyanobacteria Blooms

Richard Kiesling and Erik Smith, U.S. Geological Survey

The U.S Geological Survey (USGS), in partnership with the Minnesota Department of Natural Resources (MDNR), the St. Croix Watershed Research Station, and the National Park Service, has developed a number of mechanistic, biophysical lake models that simulate trophic dynamics and track changes in algal populations, including dominance by Cyanobacteria. For three deep, cold-water Sentinel lakes, calibrated models captured the trajectories of phytoplankton seasonal succession over time at multiple depths. Model simulations successfully tracked the seasonal dominance of cyanophytes as well as the development of lake-specific algal biomass distributions. Calibrated models were used to evaluate changes in biomass of major algal groups under changing nutrient loading and meteorological stressor gradients. In Lake St. Croix, a multi-basin, riverine glacial scour lake, a calibrated model was able to simulate the spatial and temporal development of a Cyanobacteria bloom that is known to produce algal toxins. Sensitivity analysis of the Lake St. Croix model revealed how specific parameters were driving algal bloom dynamics. Model simulations provided an understanding of how cyanobacterial production and biomass accumulation in Lake St. Croix results from complex interactions between algal physiology, lake stratification, and hypoxia in the deep pools of the lake. In all of the lakes modeled to date, dissolved oxygen distributions reflect the interactions between lake stratification, primary production in the upper mixed layer of the lake, and water column oxygen demand below the photic zone. Dynamic, mechanistic models provide the necessary tool to simultaneously evaluate the influence of multiple stressors on whole-lake metabolism.

Protecting Minnesota's Rivers with New River Eutrophication Standards

Dennis Wasley (dennis.wasley@state.mn.us), Liz Kaufenberg, Matt Lindon and Steve Weiss, Minnesota Pollution Control Agency

Surface waters in Minnesota are diverse and complex systems that require a tailored approach to protect from excess point source phosphorus loading. The recent adoption of river eutrophication standards (RES) in 2015 led to the reformed methodology MPCA uses to incorporate eutrophication standards into national pollution discharge elimination system (NPDES) permits. The MCPA has developed an implementation procedures document outlining how these limits are determined. Ultimately, this new resource - centric approach evaluates surface waters downstream of a NPDES discharger on a watershed scale. The analysis targets stream conditions where point sources are the greatest impact to downstream waters, limiting the analysis to point source contributions. Effluent limit review staff determine if existing phosphorus limits required by either previously adopted state rule or lake eutrophication standards (LES) are sufficient to protect local streams and rivers from excess algae growth. This may result in additional total phosphorus limits based on RES for some NPDES permittees. By applying both LES and RES analyses along with state rule, permitted phosphorus limits will protect aquatic life and recreation in our valued waters. MPCA has completed a number of these watershed reviews demonstrating various situations, including those where current limits are sufficiently protective, more protective limits are needed for wastewater treatment facilities, and a combination of both.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track B: Modeling and Managing Nutrient and Thermal Drivers of Aquatic Habitat *(continued)*

Climate Change Simulations of Cold-Water Fish Habitat in Elk Lake, Minnesota Using a Predictive Mechanistic Lake Model

Erik Smith (easmith@usgs.gov) and Richard Kiesling, United States Geological Survey

The U.S Geological Survey (USGS), in partnership with the Minnesota Department of Natural Resources, developed a mechanistic, bio-physical CE-QUAL-W2 model that simulates trophic dynamics and tracks changes in oxy-thermal habitat gradients for Elk Lake. Elk Lake is a deep, cold-water lake in Hubbard County, Minnesota. The calibrated CE-QUAL-W2 model captured the trajectories of water temperature and dissolved oxygen concentrations over time at multiple depths. Model simulations indicated that lethal oxy-thermal habitat develops in Elk Lake as a result of interactions between lake stratification, primary production in the upper mixed layer of the lake, and water column oxygen demand below the photic zone. The calibrated Elk Lake model was then used to future cast changes in cold-water fish habitat under the RCP8.5 (representative concentration pathways) greenhouse gas emission scenarios for the following time periods: 2025-2049, 2050-2074, and 2075-2099. The USGS National Climate Change Viewer was used to select distant meteorological stations with similar climatological characteristics during the 1950-2005 time period to compare to the future Elk Lake simulations. Results indicated that the overall percentage of lethal oxy-thermal habitat for cold-water fish would increase as the century progressed. Additionally, lethal oxy-thermal habitat would occur in the lake earlier in the year than the current (2011) calibration. Optimal habitat under current climate simulations was maintained throughout the summer period; however, optimal habitat would disappear for up to two months during the summer by the end of the century.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track C: Innovative Urban BMPs

Iron-Enhanced Ditch Checks for Captuing Phosphorus in Runoff

Poornima Natarajan (pnataraj@umn.edu) and John Gulliver, University of Minnesota; Barbara Loida, Nicholas Olson, David Bauer, James Michael, and Scot Way, Minnesota Department of Transportation; Kristine Giga and Ryan Johnson (ryan.johnson@cityofroseville.com), City of Roseville

Swales and drainage ditches are widely used along roadsides to convey and infiltrate stormwater runoff from roads. Sediment and associated particulate pollutants in runoff are filtered out by swales/ditches, but dissolved pollutant fractions are less likely to be captured in the absence of specialized filtration media, which is not part of typical swale/ditch designs. Iron-enhanced ditch checks, that incorporate an iron-enhanced sand filter insert to specifically capture dissolved phosphorus in roadway runoff, were designed, constructed, and monitored in this study. The enhanced ditch checks were constructed in two swales located in the Twin Cities Metro area, and their treatment performances assessed by field monitoring during rainfall events and field testing using synthetic runoff during summer 2015. One ditch check filter insert was found to reduce the concentration and total mass of dissolved phosphorus in the inflow runoff by 33% on average. A number of ditch checks with filter inserts would have greater overall removal. The control ditch check (without the filter insert) did not provide any dissolved phosphorus removal. Iron-enhanced ditch checks have the potential to improve the phosphorus treatment capability of swales/ditches, and thus improve runoff water quality across Minnesota.

Pump and Treat Iron Enhanced Stormwater Treatment in a Neighborhood Setting

Karen Kill (karen.kill@mnwcd.org), Brown's Creek Watershed District; Derek Lash and Ryan Fleming, Emmons & Olivier Resources, Inc.

McKusick Lake, located in Stillwater MN, was listed on the 303(d) impaired waters list for nutrient concentration which inhibits aquatic recreation. To address dissolved phosphorous loading from the Brown's Creek watershed, locations to implement an iron enhanced sand filter were evaluated. The site chosen for the application of this then-new technology is a city owned stormwater pond located in a residential neighborhood west of downtown Stillwater, MN. By using an automated pump station, drainage from a stream with a 1,200 acre suburban watershed is directed into a filter within the pond. Programming allows the pump to operate for 22 hours following rain events and increases in stream water levels, and to allow sufficient drying and iron oxidation of the filter after each event. Pumped and treated stormwater is returned to the stream through an outfall located approximately 700 feet downstream of the pump station.

Given the project is located adjacent to a city trail; stormwater education and outreach are important components of the project. Throughout the project, neighborhood meetings were conducted to obtain buy-in on the project by neighboring residents, educate the neighborhood on the system components, as well as address any concerns with the aesthetics or performance of the project.

Construction was completed in 2013. Automated sampling and water quantity monitoring has been conducted at both filter influent and effluent locations since 2014. The filter efficiency has remained consistent, averaging 82% total phosphorus removal.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track C: Innovative Urban BMPs *(continued)*

Multiple Benefits of Privately Shared Stormwater Systems: From Conceptual Design to Construction

Nathan Campeau (ncampeau@barr.com), Barr Engineering Company; Dan Kalmon, Mississippi Watershed Management Organization

This presentation is an overview of the planning, modeling, design and engineering processes that culminated in the construction of a shared, privately-owned District Stormwater System to be completed Fall 2016. The Mississippi Watershed Management Organization (MWMO), in conjunction with public and private stakeholders, coordinated the design and construction of the Prospect North District Stormwater System in Minneapolis.

The objective of this project was to build a shared District Stormwater System with added public greenspace that would meet the city's stormwater requirements at a cost equal to or less than the cost to meet city requirements on each lot individually. Through careful planning and stakeholder engagement, this objective was met.

This presentation focuses on the design of the District Stormwater System, from early concepts through final design and construction. The design process took over 3 years, beginning with early high-level concepts that demonstrated the potential cost-benefits of a district system, proving the possibility of encouraging private development, ending with final design that was coordinated with multiple public, utility, and private development construction projects. The project design included four primary components: conveyance between private property, stormwater treatment in filtration basins, underground storage for stormwater reuse, and a stormwater reuse system for irrigation of the private developments.

Urban School Retrofits: Sending Stormwater to Detention

Nate Zwonitzer (nate@capitolregionwd.org), Capitol Region Watershed District

Capitol Region Watershed District (CRWD) has worked with several schools to install innovative stormwater management projects that improve water quality and provide education opportunities for students. Installing stormwater treatment at urban schools can be challenging due to limited space, large impervious areas, maintenance requirements, and the need to preserve usable space for students. Overcoming these challenges requires planning and participation from the school community.

Through grants and design assistance CRWD was able to work with four urban schools to retrofit stormwater BMPs on challenging sites. The BMPs provide benefits beyond stormwater management including improved aesthetics, wildlife habitat, and reduced urban heat island effect. The sites include: Central High School- permeable pavers, tree trenches, rain gardens, and underground infiltration gallery with water sampling wells

Great RiverSchool Parking Lot converted to play space (pavement left in place to cap contaminated soil), rainwater harvesting for irrigation, and proprietary underground membrane filter system

Twin Cities German Immersion School - underground rate-control structure upgraded to infiltration system, multiple rain gardens, and permeable rubberized outdoor play surface

Harambee Elementary - Multiple rain gardens including conversion of parking lot island to treat large parking lot

These projects demonstrate how stormwater treatment at schools can occur even with severe site constraints. School retrofits improve water quality and provide real world demonstrations that can be integrated into curriculum for a variety of subjects. The success of recycling programs is largely due to students learning about its importance in school, and that success can be replicated with stormwater!

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track D: Groundwater and Surface Water Supply Management

Enhancing Groundwater Sources Through Enhanced Aquifer Recharge to Improve Water Supply Reliability

Kathryn Jones (kathryn.jones@hdrinc.com) and Adam Kessler, HDR Engineering, Inc: David Brown, Metropolitan Council; Kelton Barr, Braun Intertec

The Metropolitan Council, with HDR Engineering, Inc. and Braun Intertec completed a study of enhanced groundwater recharge in the seven-county metropolitan area. The objective of the study was to identify areas in the region where water applied at the surface would have the highest potential to infiltrate and recharge drinking water aquifers (both unconsolidated and bedrock aquifers).

The methodology for the enhanced groundwater recharge study included the collection and processing of existing data sets, the development of criteria to assess the potential for enhanced recharge on a regional scale, and evaluation of the data against the established criteria. Two approaches were taken. The first approach focused on using only hydrogeological criteria, including infiltration rate, parent material, hydraulic conductivity and depth to groundwater, to identify areas where water could infiltrate and potentially reach an unconsolidated or bedrock aquifer, without consideration for current land use or other human- or environmental-influenced limitations. The second approach expanded upon the hydrogeological approach to incorporate land use, sensitive natural resource areas, and drinking water protection criteria into the data calculation. The results are summarized in a set of maps which identify the areas of highest recharge potential.

The study provides a first look at the potential to supplement groundwater sources through enhanced aquifer recharge on a regional scale in the metropolitan area.

Managing Groundwater at the Local Level

Steve Woods (swoods@freshwater.org), Freshwater Society

Freshwater has released the first in a series of three groundwater reports slated for 2016-17. There are areas of the state that are experiencing multiple decades of groundwater declines. In general, municipal staff have the knowledge and skills to manage their shared aquifers in a way that does not lead to long-term declines. What municipalities may not have are a sufficiently wide range of pricing and other fiscal tools to manage water supplies when demand increases to unsustainable levels. The insufficiency of management tools increases the likelihood that higher levels of government may begin exerting influence upon municipal systems if the groundwater declines continue.

Freshwater Society will present a series of recommendations for tools for managing groundwater, policy recommendations to remove barriers to better local management, and changes in how groundwater management is funded. Tools include full-cost rates that include the basics (pump, treat, store, distribute), inter-city coordination, residential efficiency incentives, industry efficiency incentives, smart metering, and water loss reduction programs. Policy can create unnecessary barriers to getting more reuse and aquifer recovery projects built. Funding structures need to shift from the current patchwork of temporary funds to stable funding that follows through on promises made to local governments and industries, especially after the Clean Water Land and Legacy Amendment sunsets in 2034.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track D: Groundwater and Surface Water Supply Management *(continued)*

2015 Reconnaissance Study of Pesticide Compounds in Community Public Water Supply Wells

Heather Johnson (heather.johnson@state.mn.us), Minnesota Department of Agriculture, David Rindal, Anna Schliep and Todd Johnson, Minnesota Department of Health

The Minnesota Department of Health (MDH), in cooperation with the Minnesota Department of Agriculture (MDA), conducted a reconnaissance study of 135 pesticides and pesticide degradates at 108 Minnesota community public water system (CPWS) wells during February and March, 2015. Raw water samples were collected from 108 CPWS wells and analyzed for pesticides, nitrate, chloride, and bromide. Pesticides were analyzed using gas chromatography with tandem mass spectrometry (GC-MS/MS) and liquid chromatography with tandem mass spectrometry (LC-MS/MS) methods. Pesticides were detected at low levels in 72 out of 108 samples resulting in an overall pesticide detection frequency of approximately 67 percent. Detection rates were similar to those found during a previous 2010 reconnaissance study, although maximum measured concentrations were higher in 2015. Detected compounds were well below conservative health-based guidance values and there were no detections of neonicotinoid pesticides. Water chemistry indicators were used to analyze impacts of surface activity on participating CPWS wells. Results from the 2015 study, along with comparisons to the 2010 study, will be presented.

Historical Trends and Spatial Distribution of Antibiotics in Minnesota Lakes and Rivers

Jill Kerrigan (kerr0077@umn.edu), William Arnold, Kyle Sandberg and Tim LaPara, University of Minnesota; Daniel Engstrom, St. Croix Watershed Research Station

Antibiotics are not completely removed by wastewater treatments plants and have been detected in lakes and rivers that receive wastewater and sewage effluent. The presence of antibiotics in aquatic environments is concerning, because they are effective at small doses and may select for and promote the dispersion of antibiotic resistant genes. The objective of this work was to quantify the current and historical levels of selected human and veterinary antibiotics in Minnesota lake and river sediments. Twenty three antibiotics were selected from the major antibiotic classes (sulfonamides, macrolides, tetracyclines, Î²-lactams, and fluoroquinolones), as well as a few non-categorized antibiotics. The antibiotics were extracted from the sediment using accelerated solvent extraction and the extract was cleaned via solid phase extraction. A liquid chromatography tandem mass spectrometry method was developed to analyze the chemicals. The historical concentrations of several antibiotics - sulfapyridine, sulfamethazine, doxycycline, trimethoprim, lincomycin, and olfaxacin - were quantified in a dated sediment core from Lake Pepin, a natural impoundment of the upper Mississippi River on the Minnesota/Wisconsin border. In general, the antibiotics were first detected in Lake Pepin sediments after the date they were initially manufactured and distributed for human and/or veterinary use. Concentrations rose through the antibiotic era and are present at 0.5 to 20 ng/g in recent sediments.

Plenary Session II 8:10 a.m. – 9:30 a.m.

Nonpoint Source Water Quality Issues and Solutions

David Mulla, Professor and Larson Endowed Chair in Soil and Water Resources, University of Minnesota

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Prioritizing Sediment Reduction Strategies in a Large Watershed: Collaborative for Sediment Source Reduction Session Abstract

Karen Gran (kgran@d.umn.edu), Se Jong Cho, Peter Wilcock, Ben Hobbs, and Patrick Belmont

The goal of the Collaborative for Sediment Source Reduction (CSSR) is to develop a watershed strategy to reduce delivery of fine sediment to the Minnesota River from the Greater Blue Earth River basin. Key CSSR components are (i) evaluation of sediment sources, sinks, and transport, placing particular focus on independent sources of information to constrain and confirm our understanding; (ii) a reduced complexity model for both water and sediment that connects management actions to changes in flow and sediment delivery; (iii) a collaborative, multi-year process with diverse stakeholders leading to evaluation of the effect on sediment delivery of diverse conservation portfolios.

(K. Gran) We present our understanding of sediment sources, sinks, and delivery from the 9200 km2 watershed, based on multiple independent sources of information and a sediment mass balance. Although both field and near-channel sources of sediment are important, bluff erosion, enhanced by increased river flow, is currently the dominant sediment source.

(S.J. Cho) We describe a reduced complexity model that links management actions to reductions in river discharge, sediment sources, and delivery from the watershed. The model solves quickly, allowing evaluation of uncertainty and exploration of a variety of conservation portfolios in real-time with stakeholders.

(P.R. Wilcock) We describe the collaborative process and use of the CSSR model to support decision making. We examine challenges and advantages of developing a new but simple model and discuss how this approach can be applied in other watersheds.

Collaborative for Sediment Source Reduction Abstracts for Individual Talks

Greater Blue Earth River Basin: Sediment Sources, Sinks, and Delivery

Presented by Karen Gran

We present our understanding of sediment sources, sinks, and delivery from the 9200 km2 Greater Blue Earth watershed. Primary sediment sources include bluffs, ravines, upland fields, and streambanks; sinks include lakes and floodplains. An array of independent data sources, including historical aerial photographs, terrestrial lidar, aerial lidar, stream gaging, grain size analyses, and field measurements were assembled in a mass balance framework. Analysis of the sediment budget over different time periods and independent information from sediment fingerprinting provide strong constraints and confirmation of the magnitude and location of sediment sources. Although both field and near-channel sources of sediment are important, bluff erosion has become the dominant fine sediment source in recent decades. Analyses of long-term valley development indicate that bluff erosion rates are larger now than in pre-settlement times, driven by higher flows that have led to significant geomorphic changes in the last few decades including channel widening. Analysis of total suspended solids (TSS) data from paired gaging stations has shown that peak flows drive bluff erosion in the lower incised valleys of mainstem channels. Numerical modeling with SWAT indicates that efforts to increase water storage in the uplands can be effective at reducing peak flows and thus near-channel erosion downstream. The sediment budget results inform and constrain sediment reduction estimates from the management option simulation model (MOSM).

Concurrent Session IV 10:00 a.m. – 11:30 a.m. *(continued)*

Simulation Model to Link Management Choices and Sediment Delivery

Presented by Se Jong Cho

Achieving sediment reductions in a large watershed requires consideration of an array of management options and an ability to evaluate their combined effectiveness in a robust and transparent fashion. The Management Option Simulation Model (MOSM) evaluates sediment load reductions in response to different portfolios of water and sediment management options in the Greater Blue Earth River basin. Management actions are combined based on their effect on sediment sources and transport. On-field options can reduce sediment delivery by reducing erosion rate or by reducing sediment delivery ratio (fraction of eroded sediment delivered to the stream network). Near-channel options can reduce direct input of sediment from ravines and bluffs. Water storage actions reduce peak river discharge via a Muskingum-Cunge algorithm based on hydrologic inputs from a calibrated SWAT model. Reductions in peak river discharge are linked to near-channel sediment inputs with a relation between river discharge and sediment loading derived from paired gage analysis. MOSM input includes spatial extent, cost, and efficiency of management options lumped for 15 regions within the watershed. The model runs quickly, allowing for real-time comparisons of suites of management strategies. In addition MOSM:

(i) provides real-time evaluation of model uncertainty, (ii) accommodates existing information from soil mapping, stream gaging, sediment fingerprinting, and high-resolution topography, and (iii) incorporates near-channel sediment supply, which is the largest source of sediment and is not adequately represented by existing watershed models.

Linking Research and Management Choices at the Watershed Scale

Presented by Peter Wilcock

There is need for decision support for evaluating different portfolios of actions to meet water quality goals at the watershed scale. It is important to be able to evaluate many scenarios in a transparent and flexible framework that makes effective use of the best available information. Our goal in CSSR is to reach a consensus watershed strategy for a portfolio of management and conservation actions to reduce sediment loading from the Blue Earth River. We placed exceptional focus on developing a reliable understanding of sediment sources, sinks, and delivery, because conventional watershed models are unable to independently capture important sources. We captured this information in a reduced complexity model developed in a multi-year collaborative of local, state, and industry stakeholders. The model was then used with stakeholders to evaluate portfolios of management actions for reducing long-term sediment delivery from the Blue Earth watershed. The model is simple and runs quickly, such that we can develop decision frontiers and explore uncertainty with stakeholders. In this presentation, we evaluate the challenges and opportunities of using a reduced complexity model and explore the options for applying this approach in other watersheds. We also examine specific portfolios of actions that have been recommended for reducing sediment delivery and turbidity in the Blue Earth and Minnesota River Basins.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track B: Creeks, Ponds, Wetlands, and Swales

Application of the Minnesota Dry Swale Calculator

Maria Garcia-Serrana (garci683@umn.edu), University of Minnesota - St. Anthony Falls Laboratory; John Gulliver and John L. Nieber, University of Minnesota

The objective of this research was to develop a calculator that quantifies the annual infiltration performance of roadside drainage ditches or swales in Minnesota. In most cases, roadside drainage ditches receive road runoff directly and water is infiltrated over the side slope of the ditch. Water that runs off the side slopes then has a further opportunity to infiltrate as it flows down the center of the ditch. Both swales and roadside drainage ditches act as stormwater management practices.

First, a coupled overland flow-infiltration model that accounts for shallow concentrated flow was developed. This numerical model is used to estimate the infiltration performance over the side slope and channel of roadside drainage ditches for given rainfall intensities and swale characteristics. The predicted infiltration loss was then compared with the actual infiltration loss determined from monitored field tests to validate the model.

Second, sensitivity and uncertainty analyses were performed to determine the most significant design characteristics. Finally, the results were used to generate the Minnesota Dry Swale Calculator. The only inputs needed for the simplified calculator are: saturated hydraulic conductivity, width of the swale, width of the road, and the general location for rainfall characteristics. A practical application of the calculator will be provided where the water captured by the channel and side slope of a roadside swale/drainage ditch will be estimated.

Diagnosing and Mitigating Urban Wetland Impacts on Downstream Water Resources

Diane Spector (dspector@wenck.com), Jeff Strom, Ed Matthiesen and Joe Bischoff, Wenck Associates, Inc.

Wetland 27-0639W in Crystal, Minnesota receives stormwater from a 1,000+ acre urban watershed and was identified as the primary source of total phosphorus to Upper Twin Lake, a nutrient impaired lake just downstream. Wetland 639W is severely degraded from decades of untreated urban runoff, altered hydrology and legacy impacts from previous agricultural uses. Vegetative diversity is poor and dominated by a few hardy species such as cattail and reed canary grass. Recent studies on wetland biogeochemistry demonstrated that these impacts often result in wetlands shifting from nutrient sinks to nutrient transformers and exporters. However, little research is available regarding the mechanism of this shift and to identify the best solution to eliminate phosphorus export.

To develop a restoration plan to reduce phosphorus export, the Shingle Creek Watershed Management Commission (SCWMC) monitored water quality, groundwater elevations and soil chemistry to diagnose the cause of P release from the wetland. The study determined that evapotranspiration by dense cattail stands draws down groundwater during the summer and speeds mineralization of the soil. Furthermore, the soils are high in easily released iron-bound phosphorus mobilized when storm events rewet the soils. To keep more water in the wetland and limit periods of dryness, the SCWMC constructed a new weir at the wetland outlet and added a new overflow channel to the side of the wetland. Keeping the wetland wetter slows soil mineralization, limiting phosphorus release. Post construction monitoring shows that the project reduced total phosphorus exported to Upper Twin Lake by an estimated 300 pounds per year.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track B: Creeks, Ponds, Wetlands, and Swales *(continued)*

Stormwater Pond and Wetland Performance Study in Ramsey-Washington Metro Watershed District

Michael McKinney (mmckinney@barr.com), Erin Anderson Wenz and Jennifer A., Koehler, Barr Engineering Company

When under-maintained, the water quality performance of stormwater ponds and wetlands in urbanized areas can degrade over time due to sedimentation. To help the Ramsey-Washington Metro Watershed District (District) and member cities prioritize pond and wetland assessment efforts, a modeling exercise conducted using existing water quality (P8) models within the District to (a) determine the relative water quality impact of modeled stormwater ponds and wetlands and (b) estimate how quickly ponds and wetlands may be filling in due to sedimentation. By comparing and ranking the relative water quality impact and rate of sedimentation of all modeled ponds and wetlands, an assessment prioritization list was created for all four hundred ten (410) modeled ponds and wetlands within the District. Assessment prioritization lists were distributed to member cities and will be used to help guide pond and wetland maintenance efforts. Additionally, a volume sensitivity analysis was performed on the top thirty highest priority ponds and wetlands in the District to generate a cost-benefit analysis for sediment management (i.e., dredging). Modeled pond and wetland storage volumes were reduced to simulate the impact of sedimentation, and a cost benefit analysis was performed based on the change in pollutant removal and cost to dredge the sedimentation volume. The cost-benefit of sediment management was then compared to other capital improvement projects within the District. The assessment prioritization methodology, sediment management cost-benefit analysis and feedback on the tool from member cities will be presented.

Implementing a Natural Channel Design- Minnehaha Creek

Jonathon Kusa (jkusa@interfluve.com), Inter-Fluve, Inc., Michael Hayman, Minnehaha Creek Watershed District

Minnehaha Creek Watershed District has been actively engaged in restoration efforts throughout their watershed for over 48 years. Recently, the District has increased their focus on establishing a restored stream corridor along Minnehaha Creek within the City of St. Louis Park and Hopkins. The focus is on restoration of stream ecology and geomorphology, providing pedestrian connections through and across the corridor, and improving stormwater treatment of urban runoff. Prior to restoration efforts, the stream was a ditched channel, straightened, incised, and detached from its floodplains and from the community; essentially viewed as a barrier to the community and a receptacle for trash and stormwater sediment and nutrients. Over the last decade, the District has teamed with a local hospital, worked closely with local governmental agencies at the City and County level, and acquired properties along the corridor to advance the restoration of the stream corridor and adjacent properties. This presentation will provide an overview of the natural channel design approach for stream restoration within an urban context. The talk will provide an outline of the design metrics, design process, and constructed outcomes. The redesigned system includes over 1,600 linear feet of new channel length and is a novel ecosystem that balances regulated flow impacts, protection of adjacent infrastructure, sediment transport, floodplain connectivity, extensive wood placement, and ecological uplift. The first project in this area was completed in 2009 and the most recent in 2013. The projects have been tested by flooding during construction (Summer 2013) as well as historic flooding in 2014, which saw record flows and inundation extended over approximately 8 weeks.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track C: Water R1

Applying Multiple Assessment Techniques to Minimize Disturbance and Select Suitable Natural Stream Stabilization Practices

Lisa Odens (lodens@houstoneng.com) and Greg Bowles, Houston Engineering; Matt Moore (mmoore@ci.woodbury.mn.us), South Washington Watershed District

The Central Draw Storage Facility Overflow Project (CDSF) was planned to provide an outlet for SWWD's northern watershed. The CDSF begins with pumping from Bailey Lake and is primarily a "cross country" overflow route to the Mississippi River. The Lower East Ravine Stabilization Project is the 2nd constructed phase (5 planned phases) and consists of 10,00± feet of stabilization measures to address existing erosion and stability issues and provide protection from sustained CDSF pumping. Three assessment methods were used to select optimal best management practices: 1) Erosion potential: A HEC-RAS model using future conditions discharges was created to calculate shear stress and velocities, which were compared to sustainable thresholds for existing vegetative and soil conditions; 2) Stream classification: Rosgen methodology was used to classify stream segments based on LiDAR and HEC-RAS results; 3) Observed erosion: determined through site investigations. The following practices were applied to provide erosion protection to the ravine: a) vegetation management for segments with small erosion potential; b) vegetation management and woody debris riffles for segments with large erosion potential and F classifications; and c) vegetation management, rock riffles, and isolated bank stabilization for segments with large erosion potential, G classifications, and observed erosion. Applying multiple assessment methods optimized the identification of where best management practices were necessary, along with selection of the practices. Installation was completed in 2015. Photographs will be taken in the spring/summer of 2016 to document the value of these natural stabilization methods.

Elm River Intake Project - Innovative Solutions Transformed the Way Aberdeen Receives its Water

Kent Torve (ktorve@wenck.com), Wenck Associates, Inc.; Don Weigel, Clark Engineering

When the City of Aberdeen, SD experienced recurring problems with its drinking water treatment plant (WTP) intake structure, it faced a significant expense to move its intake downstream on the Elm River. Clark Engineering and Wenck Associates, Inc. partnered to produce a truly innovative and economical solution.

The Aberdeen plant is located on an oxbow of the Elm River. Each year there has been problems with clogging at the 1940's WTP intake from sediment transport and deposition due to erosion and scour of the narrow land bridge of the oxbow, and destabilization of the shoreline. The Project required design of an entirely new section of river channel. An 18,000 ton rock berm was constructed across the oxbow to stabilize the oxbow by intentionally cutting it off from the river. This allowed high sediment flows to remain in the main channel, bypassing the old oxbow and the area of the intake. The oxbow was dredged to remove sediment and connect to the shallow aquifer, and wetlands were constructed to mitigate impacts from construction of the rock filter berm. Endangered species (Topeka Shiner) were also addressed as part of 404 permit.

Through this innovative design, the City was able to avoid costly relocation and construction of a new intake and correct the on-going problems for the long term which had threatened their existing intake.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track C: Water R1 *(continued)*

Phosphorus Removal Evaluation at Mankato Waste Water Treatment Plant Done By Student-Professional Collaboration

Stephen Druschel (stephen.druschel@mnsu.edu) and Bridget Anderson, Minnesota State, Mankato

The upper Midwest rivers are suffering under high phosphorus concentrations, which causes biological stress and low ecological performances due to excessive algae growth and reducing oxygen deprivation. Waste water carries a significant amount of phosphorus which is only partially removed by traditional municipal treatment processes. In this study, analyses and evaluations were done of initiative technologies derived from clean water treatments but were applied through a "pilot plant" process to high strength waste water.

In this project, a collaboration of treatment plant operatives, waste water designers and university undergraduate students and faculty developed a cost-effective approach to evaluate potential upgrades to a treatment plant using student efforts balanced by professional guidance.

Specifically, the student team collected samples and ran analyses for upstream (influent) and downstream (effluent) flows around four membrane filtration treatments to assess performance of ultra-low phosphorus removal. Additionally, analyses were done pre and post treatment steps within the traditional treatment train. Ferric chloride, a flocculent already being used at the plant, was tried in several new injection points by the operational staff and evaluated by the student team for beneficial or detrimental effect. Evaluation of treatment was done by the collaborative team considering factors of daily averages and peak flow conditions, ferric concentrations and injection point

Developing a Stressor-Response Concept Model for Red River of the North

Tony Miller (tony.miller@respec.com), Bruce Wilson, Erich Weber and Julie Blackburn, RESPEC

The purpose of this project was to define potential nutrient targets for the Red River of the North (RRN) mainstem sites extending 547 river miles from its headwaters to Lake Winnipeg. Targets would be based on observable biological stressor-responses for nutrients and other parameters with due consideration of potential effects of light limitation from suspended solids. This International Joint Commission (IJC) sponsored project was guided by experts from Minnesota, Manitoba, North Dakota and US/Canadian Federal agencies. An extensive river algal (periphyton and seston) monitoring program was collaboratively conducted by the MPCA, Manitoba Conservation and Water Stewardship and North Dakota Department of Health over the summer of 2015. Thirty periphytometers were deployed at established stations for about one month. Extensive statistical examinations of periphyton species/metrics, nutrients and TSS data resulted in the definition of three distinct mainstem zones (1) Headwaters (2) Middle and (3) Mouth reaches. The Headwaters and Mouth reaches deployment period average TSS monitored concentrations were generally below ~150 mg/L while much higher TSS values (e.g. ~300 mg/L) were common among the Middle Reach stations. Similar zones were noted for total phosphorus. In the last portion of the RRN, TSS values declined after the confluence with the Assiniboine River coinciding with peak periphyton chlorophyll a average concentrations that frequently exceeded 150 mg/m2, noted as nuisance conditions by Minnesota water quality standards. Nutrient limits, based on multivariate analysis of algal biomass and taxonomy, indicated nutrient targets of 0.15 mg/L for total phosphorus and 1.15 mg/L for total nitrogen.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track D: Targeting Tools for Planning and Implementation

Pilot Red Lake River One Watershed, One Plan

Red Lake River Planning Group (prad0047@umn.edu), Local Governing Units; Nate Dalager, HDR, Inc.

The Pilot Red Lake River 1W1P was developed for the Red Lake River and Grand Marias Outlet watersheds in northwest Minnesota. The Red Lake River Planning Group was formed, of local units of government, for the plan's development and implementation. The planning area included portions of Polk, Pennington, Red Lake, Clearwater, and Beltrami counties. The objective of the Pilot was to synthesize one comprehensive watershed plan aligning local water planning with additional input from regional, state and federal plans, studies and data to produce a 10-year integrated, prioritized, targeted and measurable implementation plan. The watershed was divided into three planning zones given distinct geomorphic characteristics and needs. Existing data, plans, studies and a public survey were used to inform stakeholder consensus on priority issues. Prioritization criteria were developed via stakeholder consensus for assignment of prioritization classes to watershed resources. The PTMApp tool was used for targeting potential agricultural practices that were then aligned to individual water resources. Existing implementation strategies were similarly included for flood damage reduction, stream channels and floodplains, wind erosion, prairie restoration, ground water and surface water protection and program implementation, among others. 10-year measurable goals were developed using published water quality and rate targets, regional study and plan results and State management plans as well as estimates of structural and programmatic implementation targets. The results and PTMApp products from this effort will guide implementation of prioritized, targeted, and measurable strategies as defined to ensure an integrated approach to watershed planning.

Optimizing Conservation Using the Scenario Application Manager (SAM)

Julie Blackburn (julie.blackburn@respec.com), RESPEC Consulting & Services

A major challenge facing watershed decision makers is selecting the best combination of water quality management practices to implement which optimize cost-effective, achievable, and practical management strategies. The Scenario Application Manager (SAM) is a watershed-scale, decision-support tool originally developed for the Central Big Sioux River Watershed in South Dakota and has had many new features developed to promote the use of Minnesota HSPF models for making targeted management decisions at the state and local level. A key utility of this application is to facilitate prioritization and placement of best management practices (BMPs) to achieve required nutrient or sediment reductions. The decision-support framework of SAM consists of a Geographic Information System (GIS) for site selection, a Hydrologic Simulation Program Fortran (HSPF) model application to simulate nutrient fate and transport, and a BMP database. The BMP database was developed by assigning costs and reduction efficiencies to common, locally applied practices based on literature research. SAM assists in developing custom implementation plans by combining individual and/or suites of BMPs and simulating the expected reductions to the appropriate source loads represented in the continuous HSPF model. SAM also includes a cost-effectiveness optimization component for which cost effectiveness is calculated by using the total costs and reductions achieved from the application of the implementation plan. The combination of the graphical interface, a state-accepted watershed model, practical BMPs, and cost optimization bridges a gap between watershed characterization by water resource engineers and the water resource managers who ultimately develop implementation and nutrient reduction plans.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track D: Targeting Tools for Planning and Implementation *(continued)*

Implementing the PTMapp GIS toolset at Smaller Watershed Scales: Results and Lessons Learned

Jason Ulrich (julrich@eorinc.com) and Joe Pallardy, Emmons and Olivier Resources Inc.

BWSR's PTMapp (Prioritize, Target and Measure application) is a recently released GIS toolset designed for LiDAR scale identification of non-point source pollution hotspots and potential BMP sites in a primarily agricultural setting. EOR utilized the toolset in two HUC-11 watershed districts composed of mixed agricultural, rural and urban residential landuse in east-central Minnesota. After LiDAR hydro-conditioning, PTMapp generally produced satisfactory results in agricultural areas in so far as predicting landscape hydrology and resulting pollution consistent with the district's observations in these areas. However, in the case of non-agricultural areas and at smaller parcel scales, desktop and field verification of PTMapp results revealed refinement was necessary to accurately locate and characterize flow paths (i.e., presence of overland flow vs. ephemeral channel flow vs. perennial channel flow) as well as factor in the influence of the numerous wetlands and lakes that exist within the watersheds. These considerations were critical for PTMapp properly identifying and ranking pollutant hotspots at the small scale necessary for both watersheds. Refinement consisted of constraining PTMapp parameters and intermediate outputs as well as conducting considerable GIS analyses outside the toolset. The resulting products were judged to be very useful for understanding pollutant sources and distributions in the watersheds and have been instrumental in focused BMP planning and preparing BMP grant applications. These two case studies illustrate the usefulness of GIS toolsets such as PTMapp when significant field verification and refinement of results are possible.

Grid-Cell Swat Modeling Breaks New Ground on Isolating Pollutant Source Areas and Quantifying BMP Benefits

Greg Wilson (gwilson@barr.com) and Evan Christianson, Barr Engineering Company

Traditionally, watershed-scale models lump input parameters such that landscape interactions cannot occur and response unit loads are individually routed to the subbasin outlet, regardless of their location in relation to the stream network or conveyances. BMP planning tools and/or terrain analysis can target implementation locations, but do not explicitly simulate pollutant fate/transport and account for BMPs in series. Watershed practitioners have to use one tool to compensate for limitations of another.The MPCA and the Cedar River Watershed District sponsored this work with the goal of producing feasible modeling scenarios that provide small-scale, GIS output for use in discussions with the farming community. As agricultural professionals are used to dealing with crop type/rotation, tillage and residue, and fertilization of commodity crops, the modeling addressed these elements while providing output that identified the largest pollutant sources and evaluated combined effects of BMPs at a watershed scale. For this work Barr developed a first-of-its-kind grid-cell SWAT model of two watershed areas. Grid-cell discretization is available in SWAT, but is not supported by a graphical user interface. BMP modeling scenarios compared changes to cropping, tillage, fertilization rate, conservation drainage and strategic implementation of grassed waterways/filter strips or regional wetland restoration to baseline conditions. Modeling results will be presented along with a discussion of key considerations for BMP selection and siting, along with comparisons to other tools and models.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track E: Waters of the United States Rules

Wetland Protection vs. Drainage Rights

Rinke Noonan, Attorneys at Law, St. Cloud, Minnesota; Don Parrish, American Farm Bureau Federation, Sr. Director of Regulatory Issues; Scott Strand, Minnesota Center for Environmental Advocacy

The Waters of the United States (WOTUS) Rules were proposed to be implemented last fall by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency, when the Sixth Circuit U. S. Court of Appeals issued a nationwide stay against its enforcement on October 9, 2015, because it was determined to be at odds with the earlier Supreme Court Raponos ruling. These rule changes are contentious, with passionate stakeholders on both sides, pitting environmental issues against landowner rights.

In this session there will be presentations by drainage attorneys familiar with the legal status of the current stay who will explore the potential life of these rules when the stay sunsets. There will also be viewpoint presentations supporting and opposing the proposed new rules.

This session presents a great opportunity to learn about the WOTUS rules and the merits/concerns associated with the proposed rule changes.

Luncheon Presentation 12:15 p.m. – 1:00 p.m.

Introduction

John Linc Stine, Commissioner, Minnesota Pollution Control Agency

Remarks

Honorable Mark Dayton, Governor of Minnesota

Further Remarks and Q&A

John Linc Stine, Commissioner, Minnesota Pollution Control Agency

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track A: Near Channel Sediment Erosion

Influences on Lateral Erosion Rates in Three Agriculture-Dominated Minnesota Watersheds

Jen Oknich (okni0001@umn.edu), Chris Lenhart, Gary Sands, Mikhail Titov, Ben Underhill, and Laura Triplett, University of Minnesota; Mark Ellefson, Department of Natural Resources

Fourteen percent of Minnesota's impaired waters are listed for excessive turbidity. In-channel and near-channel erosion are commonly cited as the major contributors to Minnesota's turbidity problem. This MDA-funded research project sought to determine the primary drivers of stream bank erosion in the Elm Creek, Buffalo River and Whitewater River watersheds, with a goal of providing guidance and decision tools for the reduction of stream bank sediment sources. The major question addressed here was how lateral stream migration rates were influenced by grass versus tree coverage.

Several methods of calculating lateral channel erosion were compared, including two GIS-based tools (those by Mark Ellefson, and Mikhail Titov), and several common methods (BEHI, BSTEM, BANCS). A range of variables (including slope, sinuosity, NBS, bank height and others) was measured across nearly 240 reaches of the three watersheds and compared to lateral erosion rates, using these GIS tools.

The results indicate that variables commonly associated with high erosion rates are not necessarily the prominent drivers of erosion in these watersheds. Ultimately river mile was most correlated to erosion rate in these systems. The results showed no correlation between cover type and erosion rates. The expected completion date of this work is late summer 2016. However, the lateral migration data was used to develop region-specific stream bank erosion prediction graphs that are being used in TMDLs for predicting sediment loading.

Sediment Load Reduction Treatments in MN River Valley Streams

Martin Melchior (mmelchior@interfluve.com), Inter-Fluve; Ryan Holzer and Paul Nelson, Scott County

This talk will briefly review the collaborative processes used to help guide decision making and prioritization of projects intended to reduce sediment loading into the Minnesota River from streams in Scott County. Meetings, workshops and design charrettes involving various stakeholders were held to evaluate the conclusions from geomorphic assessment in the Sand, Credit and Porter Creek other watersheds. Scott County shifted its focus from streambank stabilization to bluff and ravine stabilization based on these collaborative discussions. Several projects have been undertaken since 2012, and this talk will review the design and construction of four example projects. One project features incised ditch restoration of an unnamed tributary to the MN River. Ravine stabilization on a second unnamed tributary involved grade stabilization and flow management. The remaining projects include engineered large wood treatments to reduce Sand Creek bluff inputs and relocation of Porter Creek away from bluffs.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track A: Near Channel Sediment Erosion *(continued)*

Discharge-TSS Relations Yield Useful Information Regarding Controls on Fine Sediment Production and Transport in Rivers Throughout Minnesota

Angus Vaughan (angus.a.vaughan@aggiemail.usu.edu) and Patrick Belmont, Utah State University

We analyze recent total suspended solids (TSS) data from 45 gages on 36 rivers throughout Minnesota. Watersheds range from 32 to 14,600 km2 and represent a variety of distinct settings in terms of topography, land cover, and geologic history. Rivers throughout the state exhibit three distinct patterns in the relationship between discharge and TSS: simple power functions, threshold power functions, and supply limited (inverse) power functions. Differentiating rising and falling limb samples, we generate rating curves of form TSS = aQb, Q being normalized discharge. Rating parameters a and b describe the vertical offset and steepness of the relationships. Rising limb a values range from 5 to 202 mg/L, while b values range from -2.3 to 1.62.

In addition to quantifying the watershed average topographic, climatic/hydrologic, geologic, soil and land cover conditions, we use high-resolution lidar topography data to characterize the near-channel environment upstream of gages, including near-channel local relief and stream power. We use Random Forest statistical models to analyze the relationship between basin and channel features and the rating parameters, identifying morphometric variables that provide the greatest explanatory power. The models explain between 45% and 50% of the variance in the rating parameters and determine the most important predictor variables to be near-channel local relief, channel slope, watershed average slope, and proportion of lakes along the channel network. Land use and precipitation intensity are also important in the model predicting b. Results indicate that sediment dynamics throughout Minnesota can be reasonably well predicted by near-channel characteristics.

Historical Landslide Inventory for the Twin Cities Metropolitan Area

Carrie Jennings (cjennings@freshwater.org), Freshwater Society; Mary Presnail and Suzanne Jiwani, Department of Natural Resources; Ethan Kurak, Jessica Palazzolo and Joshua M. Feinberg, University of Minnesota; Rachel Meier, Gustavus Adolphus College; Craig Schmidt, National Weather Service; Eric Waage, Hennepin County Emergency Management

Minnesota's wettest month in June 2014 led to widespread failure of sediment and rock. Two years prior, a similarly rainy period resulted in loss of life and property. Understanding the susceptibility of a landscape begins with an inventory of historical failures followed by an analysis of the slide types and precipitation. Hennepin County, the DNR, University of Minnesota, and the National Weather Service formed a coalition to address this issue for emergency management in an area centered on Hennepin County.

Failures were mapped onto a 1m-hillshade LiDAR DEM and a database assembled. Scars discovered on the DEM were noted and municipalities contacted for information. Slides were grouped by style of failure and geology.

The failures were primarily along the Mississippi and Minnesota river corridors which expose glacial and Paleozoic rock layers. Each unit provides unique stability issues, resulting in various styles of failure: shallow stormflow increases flow at seeps and springs and provides a low-friction failure plane; overland flow erodes ravines, accelerates head-cutting and steepens side slopes; saturated loamy glacial sediment succumbs to rotational failure.

The earliest record dates to 1879. Wet periods in the late 1890s, early 1900s, 1980s and 1990s have an increase in slides. The increase since 2010 may reflect a wetter climate and the ease of online searching. The antecedent precipitation extracted from climate archives shows that slides occurred between May and October with peaks in June and August, period of convective storms.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track B: Fine-scale Measurement and Targeting of Agricultural Practices

Water Quality Models for Establishing Site-Specific Nutrient Goals Based on Water Quality and Biological Response Variables

David Dilks (ddilks@limno.com), Hans Holmberg and Dendy Lofton, LimnoTech

The Minnesota Pollution Control Agency (MPCA) has recently promulgated River Eutrophication Standards (RES) that include thresholds for total phosphorus as well as thresholds for response variables (sestonic chlorophyll-a, diel dissolved oxygen flux, and biochemical oxygen demand). These standards have been developed for three nutrient regions across the State (North, Central, and South). While much thought and effort have been put into establishing these standards to be protective of rivers throughout Minnesota, it is also recognized that receiving waters' response to nutrient loads often depends on site-specific characteristics such as morphology, turbidity, temperature, hydrology, etc. There is, therefore, a need for practical model-based approaches to derive the site-specific relationship between nutrient loads and nutrient-related water quality and biological responses. A recent cooperative project supported by the Water Environment Research Foundation addressed this need. The effort:

1. Reviewed the nationwide range of response variables used to assess nutrient impairment;
2. Surveyed the range of available modeling tools and developed a Nutrient Modeling Toolbox containing 30 public domain models;
3. Developed a Model Selection Decision Tool, which recommends the model(s) most appropriate for a given site; and
4. Provided guidance on properly applying these tools to link nutrient levels to ecological response indicators for aquatic systems.

This presentation will describe the research and demonstrate the use of the Model Selection Decision Tool.

Targeting Conservation Opportunities to Retain Water: Working Towards Altered Hydrology Goals

Jun Yang (jyang@houstoneng.com), Mark Deutschman, Zach Hermann and Drew Kessler, Houston Engineering, Inc.

Through the watershed wide Total Maximum Daily Load (TMDL) process, numerous watersheds across Minnesota have been identified as having impairments that are affected by an altered hydrology stressor. Yet, the same watersheds often lack altered hydrology goals in their Watershed Restoration and Protection Strategies (WRAPS). In turn, they also lack "prioritized and targeted" projects that will result in "measurable" improvements to resources affected by altered hydrology. Areas impacted by altered hydrology often have degraded aquatic habitat and high sediment loads from river bank erosion. This presentation will cover a case study in the Le Sueur River Watershed where new methods were developed on top of LiDAR data to target conservation opportunities to retain water on the landscape, and measure changes in downstream hydrographs (e.g. peak discharge, peak time lag, and volume). The results build upon previous efforts that used the Soil and Water Assessment Tool (SWAT) to targeted storage goals at coarser scales (i.e. HUC 12 watersheds) to target specific opportunities on the landscape for Best Management Practices that would work to reduce stress caused by altered hydrology.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track B: Fine-scale Measurement and Targeting of Agricultural Practices *(continued)*

Clay County Drainage Site: Field Scale Drainage Research in the Minnesota Red River Valley

Stefan Bischof (stefan.bischof@state.mn.us), Minnesota Department of Agriculture

Minnesota's Red River Valley is experiencing an increase in subsurface drainage tile installation. In this region of silty clay loam soils, drainage tile is installed to remove excess soil water to facilitate earlier agricultural fieldwork and improved soil conditions for crop growth. In 2010, the Minnesota Department of Agriculture established a 155 acre field-scale research project in Clay County, to monitor environmental impacts of surface and subsurface drainage from agricultural fields in the Red River Valley. The instrumentation and layout of the site offers an opportunity to address a number of critical water related issues in the valley. The site includes one surface and six subsurface drainage plots, monitored separately to collect hydrologic, nutrient and sediment characteristics. Five site data years are available, initial results estimate 61% of subsurface drainage has occurred between May and June. Annual mean flow weighted nitrate-nitrogen concentrations in subsurface drainage ranged from 3.7 mg/l to 23.7 mg/l, with highest concentrations in June and July. Annual mean flow weighted total phosphorus concentrations ranged from 0.04 mg/l to 0.08 mg/l. Long term water quality and quantity data from these plots will enhance our ability to gain an understanding of the hydrologic effects of subsurface drainage in the Red River Valley's agricultural landscape.

Runoff Risk: A Decision Support Tool for Nutrient Application Timing

Dustin Goering (dustin.goering@noaa.gov), Steve Buan and Liz, Houle, National Oceanic and Atmospheric Administration, National Weather Service; Heather Johnson, Minnesota Department of Agriculture

Non-point source nutrient runoff is a significant factor contributing to degraded water resources, such as harmful algal blooms (HAB) in the Great Lakes and hypoxia in the Gulf of Mexico. Ensuring these nutrients, required for crop production, are not transported off fields and remain in the soil is an inherent farming challenge, especially because most nutrient applications occur during the winter and spring when there is peak runoff and no vegetative cover. Edge-of-field studies reveal that the majority of nutrient loads on agricultural fields are lost during this high runoff risk time and are often dominated by a few larger runoff events. In an attempt to reduce nutrient loading to waterways, farmers have adopted a variety of conservation practices; however, most of these practices are focused on where and how to apply nutrients with minimal emphasis on the short-term timing aspect of nutrient application.

As a result, the National Weather Service (NWS) North Central River Forecast Center has partnered with several state and federal agencies, universities, and the farming community to develop the first real-time runoff risk decision support tool. The NWS's unique capabilities of national scale real-time atmospheric and hydrologic modeling to allows these partnerships to shape state-specific web-based runoff risk forecasts for 10 days into the future. The goal is for farmers to incorporate this tool into their short-term nutrient application plans. First implemented in Wisconsin in 2011, its success led to a partnership between the NWS and the Great Lakes Restoration Initiative (GLRI) to implement an enhanced version in additional states. A grid-based hydrologic modeling approach will be developed for Michigan, Ohio, Minnesota, and Wisconsin. Incorporating this tool into nutrient management planning will decrease nutrient applications before runoff events thus reducing nutrient loading to nearby waterbodies.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track C: Urban Water Quality

Alum Sulfate (alum) Treatment Facility: 18 Years of Results

Eric Korte (eric.korte@rwmwd.org), Ramsey Washington Metro Watershed District

Tanners Lake is an urban lake located in the cities of Oakdale and Landfall as well as within the Ramsey-Washington Metro Watershed District (District). This 70 acre deep lake has an average depth of 20 feet and has an immediate watershed of 1,730 acres. Tanners Lake is a recreation lake that includes a beach and boat launch and is used for swimming, skiing, and speed boating as well as fishing. Prior to 1998 the water quality of Tanners Lake was poor with high levels of phosphorus and low levels of transparency. The District embarked on a study that identified a number of water quality improvements for Tanners Lake and its subwatershed. The Tanner Lake Alum Treatment Facility was one of those projects. The alum treatment facility became operational in 1998 and treats the majority of stormwater inflows coming from the 1700 acre subwatershed. The facility injects alum into the stormwater, which causes phosphorus to precipitate and then flocculate and settle in a sedimentation pond. This highly successful project has resulted in removals of up to 88 percent of all phosphorus entering the facility in a typical hydrologic year. This project along with others in the watershed resulted in the delisting of Tanners Lake from the Minnesota Impaired Waters list. This presentation will focus on the 18 years of monitoring and results as well as discussing the challenges as well as lessons learned of operating a treatment plan and the maintenance involved with the plant and the sedimentation pond. The presentation will also discuss the cost effectiveness of this best management practice (BMP) and compare it to other traditional BMPs.

Implementing an Adaptive Management Approach for an Alum Treatment on Bald Eagle Lake, MN

Brian Beck (bbeck@wenck.com) and Joe Bischoff, Wenck Associates; William James, University of Wisconsin; Matt Kocian, Rice Creek Watershed District; John Holz and Tad Barrow, HAB Aquatic Solutions

Bald Eagle Lake is a highly used recreational lake in the northern suburbs of the Twin Cities Metropolitan Area that routinely experienced cyanobacteria blooms. An aluminum sulfate (alum) dosage of 100 g/m2 was estimated to inactivate redox-sensitive P in the top 10 cm of profundal sediments. Half of the alum dose was applied in the spring of 2014, which was followed by sediment coring to assess changes in sediment chemistry and the reduction of phosphorus release from sediments. Sediment core results indicated that the initial alum application reduced sediment phosphorus release by 67-94% in shallow areas and by 12% in the deepest portion of the lake. Surprisingly, aluminum recovery in the sediments was relatively low with only 33% to 70% of the applied aluminum recovered in any of the sediment cores. These results suggested that the alum floc may have dispersed over a larger area than intended during the 2014 application, possibly due to wind mixing during spring turnover that caused horizontal floc dispersion during settling. This information was used to refine the second alum application, completed in April 2016, by increasing the alum dose in deep areas and decreasing the alum dose in select shallow areas. Furthermore, caution was taken during the second application to limit alum application in high wind conditions and to make multiple passes to ensure a more even coverage. Using multiple alum applications combined with sediment investigations can optimize internal load reduction and cost effectiveness for alum treatments.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track C: Urban Water Quality *(continued)*

Automated Baseflow/Stormflow Separation and Load Calculation for Continuous Flow Data and Water Quality Samples in Urban Storm Sewers

Britta Suppes (britta@capitolregionwd.org), Joe Sellner and Bob Fossum, Capitol Region Watershed District

The Capitol Region Watershed District (CRWD) implemented a water data management software (Kisters WISKI) with the goals of: organizing and storing all years of continuous and discrete monitoring data in one database; improving data processing procedures; enhancing data analysis and reporting; and improving data sharing capabilities. CRWD sought to increase efficiency, consistency, and accuracy in data processing and analysis procedures through the software. In working toward these goals, CRWD utilized the software to develop automated methods for (1) separating baseflow and stormflow in continuous discharge datasets, and (2) calculating stormflow and baseflow pollutant loads. These two scripts combine to produce automated load calculations for baseflow and stormflow periods that are more efficient, consistent, objective, and accurate than manual methods.The flow separation script determines the start and stop times of storm events by evaluating the continuous discharge data against five parameters whose numeric values can be adjusted to accommodate individual station and watershed characteristics.Baseflow volume is continuous and during an event is estimated using a constant slope method. Stormflow volume is calculated as the difference between the total flow volume and baseflow volume in the defined event interval. The load calculation script calculates baseflow and stormflow pollutant loads using the volume outputs of the flow separation script in combination with measured pollutant concentrations. Baseflow loads are calculated as a function of the monthly baseflow volume and the historical monthly median baseflow pollutant concentration. Individual storm event loads are calculated using a mass balance approach and sampled storm concentrations.

Treating Direct Discharges and Reducing Pollutant Loads to the Mississippi River: A Regional Approach to Implementing Green Infrastructure in the NE Industrial Area

Lisa Vollbrecht and Noah Czech, City of Saint Cloud; April Ryan, SEH Inc.

The City of St Cloud has set out to tackle water quality in a 367 acre watershed consisting primarily of industrial and commercial land use. This area was developed prior to any water quality standards being in place and prior to this work discharged directly to the Mississippi River with little to no stormwater treatment. The City is taking a number of steps to address the water quality concerns to help protect the Mississippi River, the City's sole drinking water source. The City completed a watershed assessment in 2012 which utilized WinSLAMM software to quantify pollutant loads and then identified and prioritized a list of over 20 potential implementation projects. (The assessment results were presented at the 2013 WR Conference). Since 2013, the City has secured funding and to date has implemented seven projects ranging from a large underground regional treatment facility, impervious reduction and creation of green space, sump structures, and bioretention facilities. The City's efforts also include property owner education, ordinance enforcement, meetings with large industrial properties and the purchase of a street sweeper with increased sweeping frequency. The presentation will include an overview of the steps taken to achieve the comprehensive approach (funding, partners, stakeholder support, project prioritization, etc.); treatment results of implemented projects based on updated WinSLAMM modeling and actual observed results; project costs compared to treatment levels; design challenges, construction challenges, working with property owners, city goals and expectations, the overall implementation sequencing, and the City's continued efforts moving forward.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track D: Bridge and Infrastructure Issues

Two and Three-Dimensional Simulation of Bridge Pier Scour Development in the Mississippi River

Nicole Bartelt (nicole.bartelt@state.mn.us), Petra DeWall and Solomon Woldeamlak, Minnesota Department of Transportation; Ali Khosronejad, Fotis Sotiropoulos and Trung Le, St. Anthony Falls Laboratory, University of Minnesota

The I-694 bridge over the Mississippi River is the only interstate bridge in Minnesota that is rated "scour critical". The bridge is located just downstream of a flow split and confluence around a large river island, which creates very unique flow patterns. That coupled with the unusual foundation configuration of the bridge (multiple substructure units of different piling lengths) meant a much more robust hydraulic analysis and scour study was necessary to reliably compute scour potential at this location.

Saint Anthony Falls Laboratory (SAFL) developed a three-dimensional (3D) fully coupled flow and sediment transport model, the Virtual Flow Simulator (VFS-Rivers), of the Mississippi River at the I-694 bridge under the 100-yr and 500-yr flood conditions. MnDOT provided bathymetry and acoustic Doppler current profiler (ADCP) data to validate the flow field computations of the CRF-Rivers model. The study was completed in February 2016. The study results show maximum scour depths at each pier and location of that maximum scour depth along the pier.

Additionally, this presentation will review a two-dimensional (2D) model of this river reach, developed in SRH2D, and compare the results between the 3D and 2D simulations. Also covered will be how MnDOT is using the study results to provide a stronger sense of flood implications for this bridge, assist bridge staff in monitoring scour conditions into the future, and consider revising the scour critical rating.

Mitigating Bridge Scour Case Study from the I-90 River Bridge and Interchange Reconstruction

Nicole Bartelt (nicole.bartelt@state.mn.us) and Petra DeWall, Minnesota Department of Transportation; Lisa Goddard, SRF Consulting Group

The I-90 bridge crossing of the Mississippi River is a heavily used route between Wisconsin and Minnesota. The existing bridge is fracture-critical, and its replacement is currently under construction. MnDOT performed the hydraulic analysis for the new, which showed that the piers could result in the formation of very deep scour holes, up to 43 ft. and 45 ft. in the 100-year and 500-year flows respectively. The soil type on the west side of the crossing and the significant changes in elevation in that area meant the potential scour hole depth was crucial for the global stability analysis of the retaining walls and abutment on that bank. Other relevant factors include a lock and dam immediately upstream, wide floodplain with important backwater areas, and fill material placed in the area.

MnDOT and the consultant team worked together to determine the appropriate parameters for use in the global stability analysis. Initial results indicated that the scour hole could have the potential to undermine the proposed retaining walls. Therefore, a strategy to mitigate scour hole formation was crucial.

Initial calculations showed that scour protection would need to extend 90 ft. in all directions from the pier. However, the river is particularly deep in this area, making it difficult to ensure proper placement of traditional techniques to the correct depth. Furthermore, these would have required significant excavation of the river bed, potentially impacting the river water quality. MnDOT and the consultant team designed a system of geotextile containers and riprap that would allow placement of filter material and riprap of the correct thickness in the river bed and on the steep banks. Based on this design, it was determined that the formation of scour holes in the vicinity of the west bank could be eliminated from the final global stability analysis.

This presentation is intended to follow one presented by SRF Consulting Group for the same project.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track D: Bridge and Infrastructure Issues *(continued)*

Drainage Dilemmas in Bluff Country - Case Studies from the I-90 River Bridge and Interchange Reconstruction

Jeremy Nielsen (jnielsen@srfconsulting.com) and Lisa Goddard, SRF Consulting Group, Inc.

SRF led a team of 10 sub-consultants in the design for the reconstruction of the roadway approaches to the I-90 crossing of the Mississippi River that included 3 miles of retaining walls and 7 inland bridges. The highway drainage design presented a number of challenges given the steep topography of the area, condition of the existing very deep drainage pipes, and the narrow roadway corridor adjacent to a railroad and the River for much of its length. In addition to an overview of the project, this presentation will focus on some of the more unique challenges:

Four existing flumes conveyed drainage from high on the westerly bluff and connected to culverts draining under the roadway toward the adjacent railroad. The inlets were difficult to access, leading to deferred maintenance and complete loss of functionality at 3 of the locations. The analysis addressed concerns about disturbing the bluff face and long-term functionality.

Several pipes crossing the corridor into the CP Railway right-of-way were affected by the road widening and profile changes. The depth of the existing pipe made it impractical to replace all pipes without impacts to the railroad or causing significant road closures. Each location was assessed for condition, ability to replace or line, and the effects on pipe velocity and scour.

Pipe lining techniques were considered for steep pipes that could not be replaced (drops up to 45 ft. from upstream to downstream) and were evaluated for the situation and resultant high pipe velocities. Special energy dissipation measures were then designed to offset the increased pipe and outlet velocity.

The nature of the soils and bedrock along with the significant change in elevation created the potential for global soil failure in the vicinity of the west bridge abutment. To counteract this, a special detail was developed to address scour around the piers and abutment of the new river bridge.

Trunk Highway 53 Location

Jonathan Libby (jon.libby@kimley-horn.com), Kimley-Horn and Patrick Huston, Minnesota Department of Transportation

Highway 53 in Virginia, MN, is being relocated to make way for the expansion of a nearby mine. The centerpiece to this effort is a bridge spanning the water-filled Rouchleau Pit, which serves as the drinking water source for the City of Virginia. The bridge will be the tallest in Minnesota and innovative approaches to drainage design were necessary to avoid discharging roadway surface runoff directly into the water below. The timeframe for design was severely limited due to the client's obligations with the mining company. Hydraulic design was governed by a number of unique parameters including the protection of the Rouchleau Pit and conveyance of stormwater at the abutments of the bridge where special energy dissipation measures were proposed that incorporated design research from the St. Anthony Falls Laboratory in Minneapolis. Due to the presence of rock and nature of geology, infiltration was forbidden within 500 feet of each abutment, so flow diversion practices were used to minimize the volume of discharge in addition to the energy dissipation measures. The project reaches through an ecologically sensitive area and wetland protection was crucial to the surface water quality practices selected. This project is a prime example of agency coordination from the local to federal level and the successful implementation of the Construction Manger General Contractor (CMGC) process.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Stormwater Research Priorities and Pond Maintenance Research Project

A Stormwater/LID Extended Session

Multiple presenters from the research team cited below.

1:15

Project overview and session objectives

This research project is developing information required to improve stormwater pond maintenance and create a ten year framework of stormwater research needs.

1:20 – 1:45

PAH and Phosphorus release from stormwater ponds - Research Quickbyte

An overview of a current research project (2016-2018). What is being studied, how, and why.

1:45 – 2:45

Minnesota Stormwater Research Framework and Priorities

An overview of the project (2016-2018) including project design, input for existing research and databases, and summary of an interim needs report.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track A: River Hydrology and Suspended Sediment

Modeling the Influences of Riverine Hydrology on Near-Channel Nesting Habitat for State-Listed Turtle Species

Jason Naber (jnaber@eorinc.com), Jason Ulrich and Mike Talbot, Emmons & Olivier Resources

Wood and spiny softshell turtles are two riverine species in Minnesota that are dependent upon near stream nesting habitat. The hydrologic regimes of rivers that support these two state listed species are distinct, and varied across the population range. Hydrologic alteration due to watershed and climate change creates challenges for turtle adaptation as well as conservation efforts. Wood turtles and spiny softshells both require dry sandy substrate for successful egg incubation. Many of these sandy nest sites are often created by spring flood events that move sediment or create cut bank/point bar fluvial features. Conversely, eggs from these species perish if nests become inundated by flood events during the summer incubation period.

This project conducted for MN DNR investigated the physical characteristics of nesting sites for these two species, and used hydrologic and hydraulic models to calculate flow depths associated with flood events that affect summer nesting habitat. Field-surveyed cross sections of confirmed and potential nest sites were input into hydraulic models to predict the frequency and duration of flooding, and thereby assess each site's annual likelihood of successful recruitment. Findings of this study are being used select priority nest sites (above frequent summer flood heights) to conduct nest site management. In a much broader management context, the results of this work inform our understanding of how altered river hydrology affects these turtle species dependent upon natural, free-flowing rivers. The study also illustrates the usefulness of hydrologic and hydraulic engineering techniques in riverine wildlife conservation efforts.

Application of Dimensionless Sediment Rating Curves to Predict Suspended-Sediment Concentrations, Bedload, and Annual Loads for Rivers in Minnesota

Joel Groten (jgroten@usgs.gov), Christopher Ellison, David Lorenz, U.S. Geological Survey; Karl Koller, Minnesota Department of Natural Resources

Collection of sediment data at every river location of interest is not feasible because of the cost and time associated with data collection. However, dimensionless sediment rating curves (DSRCs) can be developed from collected sediment data to estimate sediment information for unsampled rivers. This study evaluated the abilities of DSRCs to predict measured suspended-sediment concentrations (SSCs), bedload, and annual sediment loads for selected rivers in Minnesota. Regionally-based DSRC models were developed based on data collected in Minnesota from 2007 through 2013. Other DSRC models were developed by Rosgen using data from agroup of streams located in the San Juan River Basin near Pagosa Springs, Colorado and applied to rivers in Minnesota. Models developed using data from Minnesota were more effective than models developed by Rosgen at compensating for differences in individual stream characteristics across a variety of watershed sizes and flow regimes. However, deviations from measured and modeled data were observed for streams with limited sediment supply and for rivers in southeastern Minnesota. Compared to Rosgen models, Minnesota models had regression slopes that more closely matched the slopes of site-specific regression models and approximated annual loads more closely. Furthermore, Minnesota-based models had larger Nash-Sutcliffe Efficiencies and lower model biases than Rosgen models. Practitioners are cautioned that reliability of DSRCs is dependent upon representative measures of bankfull streamflow, SSC, and bedload. Model estimates of SSC and bedload can be used for stream restoration activities and for estimating annual sediment loads for streams where little or no sediment data are available.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track A: River Hydrology and Suspended Sediment *(continued)*

Indicators for Altered Hydrologic influences on Fluvial Geomorphology and Sediment Loading

Alex Schmidt (alschmidt@houstoneng.com), Greg Bowles and Drew Kessler, Houston Engineering

Throughout much of southern Minnesota eroding ravines contribute to water quality issues, a condition often exacerbated by excess water. Yet, few field studies have documented the complex relationship between the magnitude and duration of storm events and the impacts on ravine erosion. A case study conducted at Shattuck-St. Mary's School presented a unique opportunity to evaluate this relationship. A P8 water quality model and HydroCAD storm water model were developed for the Shattuck-St. Mary campus to target locations for conservation practices that reduce overland sediment, nutrient, and hydrologic loading delivered, through the ravines surrounding the campus, to the straight river. The results of the case study suggest that, even when practices are put in place that reduce peak discharge, ravines may continue to erode substantially, on the order of hundreds of tons of sediment, if the depth and duration of hydrologic loading to the ravine is prolonged above the magnitude of a 2-year return period event. The results of this study can be used elsewhere to help guide the targeting and evaluation of conservation practices that are aimed at retaining water to manage hydrologic loading to ravines and streams with the goal of reducing near-channel erosion and promoting fluvial geomorphic stability.

Flow-related Dynamics in Suspended Algal Biomass and Its Contribution to Suspended Particulate Matter in an Agricultural River Network of the Minnesota River Basin, USA

Christy Dolph (dolph008@umn.edu), Amy Hansen and Jacques Finlay, University of Minnesota

Factors controlling phytoplankton dynamics in lotic systems are still poorly understood relative to those in standing waters, especially in smaller and mid-size streams. Here, we evaluate relationships between stream flow, nutrients, suspended algal biomass and particulate organic carbon over multiple years for the Le Sueur River watershed in southern Minnesota. We found that mid-size reaches (4th-6th order) yielded higher chlorophyll concentrations than smaller reaches (1st-3rd order); however, all reach types exhibited chlorophyll concentrations that could be considered eutrophic. Over time, the highest levels of suspended algal biomass across the river network were associated with intermediate-high flow conditions (above median discharge but below ~25% exceedance probabilities). Lakes and wetlands were identified as sources of suspended algal biomass throughout the stream network. Suspended algae accounted for approximately 20% of total suspended carbon in the river network, on average, but could be considerably higher or lower depending on individual site characteristics and flow conditions. Nutrient-chlorophyll relationships suggested that suspended algae may affect stream nutrient concentrations via uptake, but nutrients likely do not limit algal growth at most sites. Our findings highlight the importance of flow as a regulator of suspended algal biomass, and suggest that many flow events may act to mobilize algae from benthic or lentic areas locally productive areas. The importance of lakes and wetlands in contributing to network algal biomass also has implications for predicting the effects of nutrient management scenarios that would increase water storage on the landscape.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track B: Watershed Monitoring Assessment and Dissemination

An Interactive Application for Graphing and Downloading Daily, Annual, and Average Pollutant Load Data From the MPCA's Watershed Pollutant Load Monitoring Network

Patrick Baskfield (pat.baskfield@state.mn.us) and Casey Scott, Minnesota Pollution Control Agency

The Clean Water Land and Legacy Amendment is providing an unprecedented opportunity to enhance monitoring of Minnesota waters and our understanding of the relative contributions of pollutants from various sources and waters. One example is the Minnesota Pollution Control Agency's (MPCA) Watershed Pollutant Load Monitoring Network (WPLMN), a long-term statewide river monitoring network initiated in 2007 and designed to obtain pollutant load information from 199 river monitoring sites throughout Minnesota. The program utilizes state and federal agencies, universities, local partners, and MPCA staff to collect water quality and flow data to calculate nitrogen, phosphorus, and sediment pollutant loads. This presentation includes a brief overview of the WPLMN followed by a detailed demonstration of a recently developed interactive application that allows the user to graphically review and download daily, annual, or average pollutant load, yield, or concentration data calculated by the WPLMN. The application combines spatial, graphical, and tabular data capabilities into one interface and allows the user to gain a better understanding of: the geographical distribution of stream water quality throughout the state; temporal variability in water quality; and the timing and delivery of pollutant loads to stream systems.

Estimating Daily Streamflow for Ungaged Stream Locations in Minnesota

Jeff Ziegeweid (jrziege@usgs.gov), David Lorenz and Christopher Sanocki, United States Geological Survey Minnesota Water Science Center

Effective management of water resources requires knowledge of the quantity and quality of available water. In Minnesota, total maximum daily loads will be established for pollutants in 1,649 impaired stream reaches. Daily streamflows are required to establish total maximum daily loads, but streamgages cannot be installed at every location. The U.S. Geological Survey, in cooperation with the Minnesota Pollution Control Agency, developed methods for estimating daily streamflow at ungaged locations. The study area included 196 streamgages located within Minnesota and 50 miles beyond the border in surrounding states. Selected streamgages had at least 10 years of continuous streamflow data and streamflows not substantially affected by regulation, diversion, or urbanization. The study area was divided into five regions developed using the concept of hydrologic landscape units. Weighted, left-censored regression was used to develop equations for estimating 23 streamflow statistics for each of the five regions. In addition, 25 pairs of streamgages were used to develop a statewide drainage-area ratio equation for estimating streamflow statistics at ungaged locations on streams with a streamgage in another location. Equations were incorporated into StreamStats, a web-based tool developed by the U.S. Geological Survey. StreamStats can be used to estimate daily streamflows at ungaged locations. Instructions for estimating daily streamflows are presented in two published reports.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track B: Watershed Monitoring Assessment and Dissemination *(continued)*

Long Term Trends in Concentration and Loads of Stream Pollutants in Minnesota

James MacArthur (jim.macarthur@state.mn.us) and James Jahnz, Minnesota Pollution Control Agency

Evaluating and presenting stream pollutant trend data is complicated by large fluctuations in chemistry over seasons, years, and flow regimes. Changes in sampling frequency, sample point location, method of analysis, laboratory and detection levels further complicate these analyses. Flow data is required in order to extend the analysis from chemistry trends to trends in loading. This introduces the additional complications of changes in gaging method and location, gaps in gaging and changes in the flow regime over time. Application of ordinary statistical techniques is further complicated by the non-parametric nature of the data and consequent restriction in appropriate techniques.

USGS has recently released a software package designed to simplify and streamline many aspects of hydrologic and water chemistry analysis for rivers and streams. EGRET (Exploration and Graphics for River Trends) is capable of uploading hydrologic and water chemistry data directly from common sources such as NWIS and Storet, performing a wide array of analytic techniques on data of interest, and producing a variety of graphs and figures which allow users to visualize complex results more easily.

EGRET has been used to analyze data for 30 monitoring sites throughout the state with chemistry and gaging records sufficient for long term analysis. Models were created for each site for nitrate (NO3) and nitrite (NO2), total phosphorus, and total suspended solids.

Comparing Minnesota's nutrient and sediment load monitoring results with watershed characteristics

David Wall (david.wall@state.mn.us) and Thomas Pearson, Minnesota Pollution Control Agency; Ben Gosack, Minesota Department of Natural Resources

Minnesota's diverse watersheds have been intensively monitored for river nutrient and sediment loads for over seven years. The results from 60 individual watersheds from across the state show a wide range in loads and concentrations. For example, average flow-weighted mean concentrations (FWMCs) range from 0.03 to 9 mg/l for nitrate-N, 0.02 to 0.5 mg/l for total phosphorus (TP), and 2 to over 300 mg/l for total suspended sediment (TSS). We compared watershed nitrate, TP, TSS and orthophosphorus FWMCs and yields with watershed characteristics, including: land uses, crops, soils, hydrology, geology, precipitation, artificial drainage, point source discharges, livestock manure, and other watershed variables. Nonpoint sources were found to be the dominant pollutant sources in most of the studied watersheds. The watershed characteristics most closely associated with high nutrient and sediment concentrations and yields differed for each pollutant.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track C: New Tools for Salt Management

Smart Salting: Managing Salt Use to Protect the Environment, Save Money and Provide Public Saftey

Brooke Asleson (brooke.asleson@state.mn.us) and Rachel Olmanson, Minnesota Pollution Control Agency

In response to the increase in chloride concentrations in areas lakes, streams and groundwater, Minnesota state agencies and local municipalities across the Twin Cities Metropolitan Area (TCMA) have partnered to collaboratively create a Chloride Management Plan (CMP) to effectively manage salt use to protect our water resources in a responsible and strategic approach. The CMP provides understanding and guidance for management activities over the next 10 years. While this plan was developed to address chloride impacts specifically for the TCMA, the restoration and protection goals, implementation strategies, and monitoring and tracking recommendations can be applied statewide.

The CMP lays out several strategies for a wide range of audiences for managing and reducing salt use. These strategies include the use of the newly created Winter Maintenance Assessment tool (WMAt), the MPCA Smart Salting (S2) trainings, education and policy recommendation, and many other options. The highly successful level 1 S2 training has over 5,000 individuals certified and participants have reported up to 50% reduction is salt use and significant cost savings. A new level 2 S2 training has been developed and is currently being offered to provide an in depth evaluation of winter maintenance programs with hands on guidance of the WMAt. The CMP pulls together all the necessary information and resources to create the foundation for everyone to utilize in working towards achieving the common goal of clean waters.

Winter Maintenance Assessment Tool: An Innovative Planning Tool to Manage Salt Use

Matt Morreim (matthew.morreim@ci.stpaul.mn.us), City of St. Paul Public Works; Brooke Asleson, Minnesota Pollution Control Agency

Protecting Minnesota's valuable water resources, while also meeting public expectations for safe winter travel, is challenging. In an effort to bridge the gap between these two important and often competing priorities, the Minnesota Pollution Control Agency (MPCA) has partnered with leaders in the winter maintenance industry to develop solutions. As part of the development of the Twin Cities Metropolitan Area (TCMA) Chloride Management Plan, a first of its kind, web-based Winter Maintenance Assessment tool (WMAt) was developed as a resource of all known salt saving best management practices (BMPs). The WMAt is a free tool, hosted by the MPCA since February of 2016, to assist winter maintenance organizations in determining where opportunities exist to improve practices, make reductions in salt use and track progress.

The WMAt contains a list of over 200 BMPs and allows winter maintenance organizations in the TCMA to assess their current practices and evaluate potential future practices to understand how to reduce the use of chlorides, while still providing an acceptable level of service. Utilization of this planning tool will allow users to track progress over time and show results of their efforts. The tool can generate a variety of reports that summarize current practices and identify areas for future improvement. Winter maintenance managers can use the reports to communicate operations and improvements to residents, clients or elected officials. The tool can also predict salt savings for some of the BMPs based on the industry's current research.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track C: New Tools for Salt Management *(continued)*

Using "Big Data" Techniques to Analyze and Visualize Dissolved Salt Concentrations Across the Minnesota Landscape

Scott Kyser (scott.kyser@state.mn.us) and Casey Scott, Minnesota Pollution Control Agency

The objective of this project is to characterize the levels of selected dissolved salts within Minnesota. The Minnesota Pollution Control Agency has collected over 720,000 dissolved salt parameters since 2005 from 6,575 surface water sites. Staff typically use the data for local-scale review but to our knowledge the data has not been utilized at the state level. This presentation will explain how the MPCA analyzed and visualized this large data set for some of the common major ionic parameters: Total Dissolved Solids, Specific Conductance, Hardness, Alkalinity and Chloride. We will briefly summarize previous literature characterizing major ionic parameters and how this analysis furthers that work. The focus will be how we used database, geographic information system (GIS), and statistical tools and methodologies to characterize dissolved salt concentrations. Several of these common ionic parameters are related and we will analyze and interpret potential correlations. We will also present statewide background concentration maps generated from this project. These maps will provide a more comprehensive understanding of ambient salt concentrations in surface waters within the state.

Revised Sulfate Standard to Protect Wild Rice from Elevated Hydrogen Sulfide

Edward Swain (Edward.Swain@state.mn.us), Phil Monson and Shannon Lotthammer, Minnesota Pollution Control Agency

In 2011 the Minnesota legislature instructed the Minnesota Pollution Control Agency (MPCA) to re-evaluate Minnesota's existing sulfate standard to protect wild rice. The MPCA sponsored research that determined that wild rice can be damaged by hydrogen sulfide produced by bacteria in the sediment, as the anaerobic microbial community decomposes sedimentary organic matter and respires sulfate. The research also demonstrated that the relationship between surface water sulfate and hydrogen sulfide is complex, and that a water quality standard to protect wild rice should acknowledge the complexities. For instance, in 2015 the MPCA issued a draft proposal to calculate a protective sulfate standard for each wild rice water with an equation that incorporates sedimentary concentrations of organic matter and iron; organic matter supports the conversion of sulfate to sulfide, and iron makes sulfide less bioavailable. In developing the proposed revision to the existing fixed sulfate standard of 10 mg/L, the MPCA compared the rate of false positives and false negatives of an range of potential fixed standards to the error rate that would be associated with custom standards calculated with the equation. The legislature instructed the MPCA to finalize any revision to the sulfate standard by January 15, 2018.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track D: Planning for Floods, Fish Passage, and Flocculation

Mitigating Geyser Events in the Minneapolis Stormwater Tunnel Systems

Brandon Barnes (BBARNES@BARR.COM), Greg Fransen, Lulu Fang, Christian Frias, and Omid Mohseni, Barr Engineering Company

Pressurization of stormwater tunnel systems is common during infrequent storm events. During rapid pressurization of stormwater tunnels, pressure surges may occur in the tunnel system. Pressure surges may result in water shooting out of drop shafts during storm events. In addition, geyser events an explosive release of an air-water mixture through tunnel drop shafts or drill holes may also occur. Geyser events are primarily due to movement of trapped air pockets during pressure surges in a tunnel system. There is a public safety risk for vehicles and pedestrians in the vicinity of drill holes and drop shafts when the shaft covers are displaced due to pressure surges.

There have been recorded geyser events in the Minneapolis stormwater tunnel systems. Three of these tunnel systems, the St. Mary's/Hiawatha, the Como Avenue, and the I35W tunnel systems were modeled and analyzed. Three models were employed to simulate inflow hydrographs (SWMM), pressure surges (Illinois Transient Model) and geyser events (OpenFOAM CFD, two-phase flow). The models were calibrated against pressure measurements collected in the tunnel systems and videos recorded geyser events. The calibration was an iterative process in running these models in sequence, with output from one model as input to the next model. The models were then used to identify the storm events during which pressure surges and geyser events could occur. Alternatives were identified to mitigate geysers events during rapid filling of stormwater tunnel systems. The simulation results were then used to design stormwater pressure dissipation chambers at the drop shafts.

Development of Planning Toolsets using XP-SWMM and GIS Systems to Address Flood Risk, Climate Change, and Urban and Rural Development

Bryce Cruey (bcruey@wenck.com) and Ed Matthiesen, Wenck Associates, Inc.

Predictive stormwater models are needed to assist watershed districts, municipalities, and other government agencies in making decisions about urban and rural stormwater management. When decision makers can visualize and quantify risk to homes and infrastructure in the face of urban and rural development or changing rainfall patterns, they can adapt efficiently.

The Coon Creek Watershed District (District) manages a 107 square mile watershed that comprises of a mix of rural and urban hydrology. Several iterations of predictive stormwater models have been created for the District over the years to support comprehensive stormwater management planning in line with the District's holistic watershed management approach. In 2014 through 2016 Wenck Associates and the District completed a major update to their predictive stormwater model. This comprehensive update included integrating geospatial databases, LiDAR topography, Atlas 14 precipitation frequencies, detailed channel condition and cross section survey data with the hydrologic and hydraulic modeling using XP-SWMM.

With this update, XP-SWMM model inputs and outputs are linked to a geodatabase that can be modified, accessed and visualized within a geographical information system (GIS) environment. This capability provides a much more comprehensive management tool that goes beyond just stormwater modeling. The geodatabase contains not only model specific information but a suite of information about the features within the model such as channel condition, culvert condition, and survey metadata information. With this tool the District can better assess floodplain risks, stormwater asset performance, effects of development, land use changes, water quality and best management practices.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track D: Planning for Floods, Fish Passage, and Flocculation *(continued)*

Culvert Inventory and Ranking Protocol

Amanda Hillman (amanda.hillman@state.mn.us), Minnesota Department of Natural Resources

Stream crossings, including bridges, culverts and fords, are abundant across the landscape. However, their individual and cumulative impacts on fish passage and stream stability are unknown. The abundance and effects of crossings are important when evaluating watershed health and prioritizing restoration. Currently in Minnesota, a statewide inventory of stream crossings does not exist. The MN DNR Stream Habitat Program started an inventory in 2013 and developed a fish barrier ranking protocol. This presentation will be an overview of standardized field methodologies and ranking protocol that can be used to create a ranked inventory of culverts across the state. A complete inventory of all (public and private) stream crossings in the Root River watershed was collected to demonstrate how this protocol can be applied. In total 622 stream crossings are located in the watershed, including 321 culverts. The barrier ranking protocol identified 8 complete barriers, 88 significant barriers and 147 partial or season barriers. There is recognition of the need to compile a statewide inventory of all stream crossings, especially culverts that can impede fish passage. This protocol provides a ranking scheme upon which we can begin to strategically target stream crossings for replacement and/or restoration. Implementing this strategic approach will serve a critical role in improving stream connectivity, biology, geomorphology, hydrology and water quality.

Flocculation BMPs for Reducing the Sediment in Construction Water Discharges

Stephen Druschel (stephen.druschel@mnsu.edu) and Nazli Yilmaz, Minnesota State University, Mankato

In many locations with fine-grained soils, traditional stormwater best management practices (silt fences, diversion ditches, temporary seeding, check dams and sediment ponds) have been observed to be ineffective in removing fine particles, frustrating construction personnel and leaving construction sites unable to meet stormwater regulations. This ineffectiveness can be particularly troubling when performing construction work over sensitive or high value waterways where stringent discharge limits must be met.

Great success has been achieved through flocculation, a chemical treatment to enhance fine particle sedimentation and filtration, commonly used in the controlled world of water treatment. In prior work, this research team brought together techniques of earthwork operations, sediment particle chemistry, mixing, and sludge management, with particular emphasis made on techniques related to stormwater ponds and earthwork site geometries. We have since found that mixing is a critical and often difficult part of the process as poor mixing can cause a reversal treatment effectiveness and make matters worse. This study evaluated on-site and in-channel mixing techniques for different stages of the treatment process. The investigation resulted in recommendations of effective and practical treatment processes that can be easily performed on construction sites using common construction materials and techniques.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Stormwater/LID Extended Session Continued

Stakeholder Input for Stormwater Research Priorities for the Next Decade

This will be an interactive input session (not a presentation). Participants will be invited to provide input to help shape future surveys, methods, and contribute to stormwater research needs.

This stormwater/LID extended session will be led by members of the UMN research team carrying out this project including:

Jeff Peterson, Larry Baker, John Bilotta, John Chapman, Jacques Finlay, John Gulliver, Raymond Hozalski, Shahram Missaghi, Matt Simcik, Bruce Wilson, and multiple post-docs and graduate students.

Poster Session 4:45 p.m. – 5:45 p.m.

1. In-Lake Response to Watershed Restoration: Lake Shaokotan, Lincoln County, MN

Ellen Albright (ealbright@macalester.edu), Macalester College; Steven Heiskary, Minnesota Pollution Control Agency

Anthropogenic land use change has altered nutrient fluxes from terrestrial to aquatic systems, resulting in eutrophication of inland waters. Lake Shaokotan is a shallow lake in Lincoln County, in southwest Minnesota. It has a long history of poor water quality associated with various forms of agricultural land use within its watershed. This project presents a narrative of Lake Shaokotan, focusing on changes in total phosphorous (TP) and total nitrogen (TN) concentrations over the past thirty years in response to watershed restoration projects. By reviewing technical reports, we reconstructed a history of in-lake conditions and management practices within Lake Shaokotan's watershed. We then compiled and summarized the long-term water chemistry data from available MPCA monitoring records. Over the past thirty years, the summer TP and TN concentrations in Lake Shaokotan reflect various phases in the management of the surrounding landscape and nearshore area. Concentrations of these nutrients declined throughout the 1990's due to initial restoration efforts, increased slightly in the early 2000's after a breaching of a feedlot manure containment structure, and then continued to decline in response to renewed watershed management. Although restoration projects were designed to address external phosphorus loading, TN decreased as well. TP concentrations were significantly lower after restoration was initiated in the catchment, suggesting that the watershed restoration efforts were successful at reducing in-lake nutrient levels. Lake Shaokotan is an informative case study on the response of aquatic systems to catchment land use and management.

2. Sampling and Temporal Effects on Arsenic Concentration in New Private Residential Wells in Minnesota

Emily Berquist (Emily.Berquist@state.mn.us), Minnesota Department of Health; Melinda Erickson, U.S. Geological Survey

Naturally occurring arsenic is elevated in groundwater throughout Minnesota posing a health risk to an estimated 100,000 private residential water well users. The Minnesota Department of Health is working in collaboration with the U.S. Geological Survey to improve understanding of arsenic mobilization mechanisms and occurrence in well water. Two study goals are to 1) determine whether different water sampling protocols and/or timing of sample collection affect arsenic test results and 2) assess whether the initial arsenic sample is representative of the long-term arsenic concentration for that well.

Three areas (south-central, west-central and northeast Minnesota) with known elevated arsenic concentrations are the focus of the study. A total of 260 newly-constructed private residential water wells were sampled at three distinct times: at the time of well construction to mimic current driller-collected samples; 3 to 6 months after construction; and one year after construction. Initial unfiltered arsenic samples were collected either off the drill rig or from the residential plumbing, according to the method used by the particular well contractor. Other samples were also collected during each sampling event, including filtered arsenic, field parameters, and certain redox-sensitive analytes. Water sampling will be completed September 2016 and statistical analysis completed in 2017.

This poster will present the study design, sampling methodology, and preliminary results. Preliminary results will include a discussion of the geochemical conditions in wells with low arsenic, elevated arsenic, and temporally changing arsenic. A statistical summary and comparison of arsenic results comparing sampling methods and sample timing will also be presented.

Poster Session 4:45 p.m. – 5:45 p.m.

3. Woodchip Bioreactors: From Planning to Construction, a case study of Faribault County Ditch (CD) 62

Chuck Brandel (chuck.brandel@is-grp.com), ISG

A wood chip or denitrifying bioreactor is a subsurface structure containing wood chips as a carbon source, installed to intercept subsurface drain (tile) flow or ground water, and reduce the concentration of nitrate-nitrogen. Bioreactors provide significant water quality benefits and many other advantages:

- They use proven technology
- They require no modification of current practices
- They do not require land to be taken out of production
- They do not decrease drainage effectiveness
- They require little or no maintenance
- Long lasting, up to 20 years (replace wood chips)

This poster will include a timeline of a case study project, budget information, funding opportunities and outcomes. Specific engineering approaches and techniques of project implementation will be shown along with the approval process. Methodologies used in the project's construction will be showcased, as well as lessons learned. Anticipated results of the project will be shared.

4. An ArcGIS based tool for Water Table Interpolation

Catherine Christenson (cchristenson@usgs.gov), U.S. Geological Survey; Tim Cowdery, U.S. Geological Survey

Understanding groundwater availability, groundwater and surface water interactions, and directional flow of water are essential for informed water resource management. An ArcGIS model-builder tool was developed to create a water-table surface from sets of synoptic groundwater- and surface water- level measurements. Model inputs include synoptic water-level elevations in point form, surface-water features in point form to be either dynamically or statically modeled, and a digital elevation model (DEM). The tool 1) extracts surface water point elevations from a DEM and corrects for synoptic water-level measurement, 2) merges water bodies into a single surface water body system, and 3) interpolates a surface between water bodies and groundwater well locations. The natural-neighbor interpolation was selected as the best method to maintain exact groundwater elevations at wells. The tool includes features that prevent the water-table surface from exceeding the land surface and stabilize edges of the surface by interpolating to user-determined point elevations beyond the interpolation area. The water-table surfaces generated by this tool can be used to better understand the directional flow of water in a given landscape, quantify changes in short and long term groundwater storage, and verify quality of field data. Further improvement of the tool could include conversion from the ArcGIS model-builder format to an ArcPy based code, which would both decrease model run times and ease model troubleshooting.

Poster Session 4:45 p.m. – 5:45 p.m.

5. Floating Treatment Wetlands in a Northern Climate: Examination of Phosphorus and Nitrogen Removal

Emily Deering (deeri019@umn.edu), Joseph Magner, Chris Lenhart and Lawrence Baker, University of Minnesota

Excess phosphorus is the largest contributor to nutrient impairment in Minnesota waters. Floating treatment wetlands (FTWs) are a novel best management practice (BMP) to reduce excess nutrients in waterbodies. This study examines the nutrient reduction efficiency of FTWs in a northern climate under agricultural loading conditions. The experiment was carried out from July 29 to October 22, 2015

The experiment consisted of 10 mesocosm tubs. Five tubs served as controls (containing only water) and five contained FTWs. Floating treatment wetlands covered 15% of the water surface area. The experiment was run in batches, with water being exchanged every seven days. The FTWs were each planted with wetland plants Juncus effusus, Eleocharis acicularis, and Glyceria canadensis.

The location of the experiment was on the University of Minnesota St. Paul campus. The water for the experiment was sourced from the Sarita Wetland Forebay. The experiment water was spiked with NaNO3 and KH2PO4 to attain the desired nitrate and orthophosphate concentrations for each batch.

Changes in total phosphorus, Orthophosphate-P, Nitrate-N, and Ammonia-N concentrations were measured in each batch. Total phosphorus and Ammonia-N concentrations were measured with a Lachat. Orthophosphate was measured with a DR/890 Hach Colorimeter. Nitrate was measured with a Nitratax SC Plus. Physicochemical parameters of water were measured with a YSI 6920 V2 to determine FTWs impact on dissolved oxygen, pH, temperature, and conductivity.

Floating treatment wetlands removed more total phosphorus than the control at a median removal rate of 0.05 g/m2/day. Eleocharis acicularis had the fastest growth rate (9.9 ± 3.6 g/m2/day) and highest phosphorus uptake rate (0.0030 g/m2/day). Mesocosms with FTWs had statistically significant lower pH ($p = .006621$) and dissolved oxygen concentrations ($p = .00556$). Further research areas and FTW design improvements are recommended based on findings from this experiment.

6. Fields to Streams: Managing Water in Rural Landscapes

Les Everett (evere003@umn.edu) and Ann Lewandowski, University of Minnesota Water Resources Center; Karen Terry, University of Minnesota Extension

Streambank, ravine, and bluff erosion are the principal sources of sediment in the Minnesota River and other rivers in agricultural areas. These sources are related to increased stream flow peaks and volumes, moderation of which will require more intentional management of water before it reaches the streams. A team of six authors and nine contributors worked together to create the two-part publication Fields to Streams: Managing Water in Rural Landscapes to assist local conservation staff when discussing rural hydrology with landowners. Part 1 contains current information on changes over time in precipitation, vegetation, agricultural drainage, stream flows, and river channel widths, concisely and graphically explaining how flow volumes interact with our legacy of glacial landforms in delivering higher rates of sediment. Part 2 presents conservation practices that can moderate and reduce flows to protect streams. Over twenty reviewers provided guidance in producing the 100-page document. It is available on-line in electronic and print versions at z.umn.edu/FieldsToStreams .

Poster Session 4:45 p.m. – 5:45 p.m.

7. Opportunities for Minnesota's One Watershed, One Plan Program

Elizabeth Henley (henle012@umn.edu), University of Minnesota

Minnesota is on the national forefront of integrated water management strategies with its statewide rollout of One Watershed, One Plan (1W1P) that began in March 2016. Key questions about the program remain, questions that may determine 1W1P's ultimate effectiveness and successful adoption and implementation throughout the state. Based on a University of Minnesota Masters Plan B Paper, this poster presents feedback on 1W1P gathered through a year-long research assistantship at the Minnesota Board of Water and Soil Resources and conversations with 1W1P pilot participants across Minnesota. The poster explores how human dimensions of 1W1P intersect with policy questions, leading to important discussions about management scale and social response to management strategies. It offers key recommendations on how to address the most pressing concerns voiced about 1W1P, including increased incorporation of private sector entities, more reliance on trusted local consultants (both governmental and non-governmental), and incentives for bringing non-typical partners to the table for a more comprehensive, unified, and successful water planning program for Minnesota.

8. Trend Assessment of Regional River Water Quality in the Twin Cities Metropolitan Area (1976 - 2014)

Erik Herberg (erik.herberg@metc.state.mn.us) and Hong Wang, Metropolitan Council

Metropolitan Council monitors water quality at 21 river locations in the Twin Cities metropolitan area to assess compliance with water quality standards, extent of pollution, and changes in river water quality. The Council has regularly monitored the water quality at these locations for a period of record ranging back to 1976.

In 2016, the Council will complete a comprehensive report on the long-term water quality trends at ten locations on the Mississippi, Minnesota, and St. Croix Rivers. Trends were calculated using data from 1976 - 2014 with USGS's QWTREND, which estimates multiple trends based on flow-adjusted concentrations to identify changes in water quality over time. Additionally, the report characterizes the general patterns of river water quality by examining annual, seasonal, and spatial variations. Trends and general patterns of water quality were calculated for several parameters, including nutrient, solid, biological, and physical components.

This poster provides a general overview of the report and displays the type of information produced by QWTREND and the general patterns analysis.

9. Evaluating Nitrogen Management and Crop Yield Through On-Farm Field trial Demonstrations

Spencer Herbert (spencer.herbert@state.mn.us), Margaret Wagner, Ryan Lemickson, Dawn Bernau, and Aaron Janz, Minnesota Department of Agriculture

Nitrate concentrations in surface and ground water are of concern for both water quality and health reasons. Nitrogen fertilizer use in agricultural production is one source of this nitrate. To help farmers manage their nitrogen fertilizer in an environmentally responsible and economically feasible way, the Minnesota Department of Agriculture developed and installed the Nutrient Management Initiative (NMI). The NMI encourages farmers and their crop advisers to install field trials on their farms, applying nitrogen management practices specific to their individual farming operations. Results allow them to evaluate new or alternative nitrogen management strategies including changes in nitrogen rate, application timing, nitrogen source, or use of a stabilizing product. Detailed agronomic and economic information is gathered to evaluate an alternative practice chosen by the farmer. Results including crop yield, nitrogen use efficiency, and economic return on investment are measured. In 2015, there were 166 NMI field trial plots throughout Minnesota, with a majority located in the southeast and south-central regions; 58 plots consisted of replicated treatments allowing statistical analyses. Results suggest that for many producers, slight reductions in nitrogen application rates will not impact yield but may provide an overall benefit to the environment. Split nitrogen application trials showed the potential to increase crop yield while benefitting water quality. Results were summarized by University of Minnesota Extension nitrogen best management practice region and compiled into a comprehensive result publication. The NMI is continuing in 2016, with the anticipation that producers and their advisers will continue to consider alternative nutrient management practices.

Poster Session 4:45 p.m. – 5:45 p.m.

10. Embankment Protection during Road Overtopping Events

Matthew Hernick (hern0122@umn.edu), Jeff Marr, Sara Mielke and Robert Gabrielson, University of Minnesota St Anthony Falls Laboratory; Craig Taylor, LimnoTech

During high flood seasons in western Minnesota, overtopping of roadway embankments by floodwaters is widespread, especially within the flat topography of the Red River of the North valley. Failure of a roadway due to embankment scour by overtopping flow is an obvious safety concern. Repairs resulting from erosion events require significant time and monetary resources as well as delaying re-opening important transportation corridors to the public. This research, funded by the MN Department of Transportation and the MN Local Road Research Board, sought to evaluate the performance of several "soft" scour prevention techniques as well as to document field overtopping events. A full scale model featuring a three-foot wide cross section of a typical two-lane rural roadway, shoulder, and erodible loam soil inslope was constructed at St. Anthony Falls Laboratory, University of Minnesota and subjected to various overtopping flows. Experiments were conducted with variations of three scour prevention techniques as well as a bare soil control. Effects of slope reduction, extending pavement onto the slope, soil compaction, and other factors were explored and documented. The research provides insights into erosional processes associated with overtopping and attempts to quantify the protection benefit from common, commercially available erosion protection methodologies.

11. Building Capacity for Natural Resources Across RSDPs

Linda Kingery and Rose Clarke, University of Minnesota Extension, Regional Sustainable Development Partnerships

The Regional Sustainable Development Partnerships serve Greater Minnesota through five regional boards RSDP brings together community talent and priorities with University research and seed funding toward sustainability goals. Sustainable development is deliberately cross-disciplinary, and developing projects with community members across Minnesota might even be seen as pan-disciplinary. In order to better connect the wide ranging work across the five regions in the focus area of Natural Resources, the RSDPs created a Conservation Corps Individual Placement position.

Three strategies of engagement are included in the framework for this pilot year. First, Conservation Corps Member (CCM) attends Natural Resources Work Group meetings in five regions to enable a flow of information across regions. Second, the CCM hosts a series of webinars that feature one University unit or researcher and one RSDP project. These webinars build familiarity both ways, between regional RSDP staff, partners and work group members, and University faculty and staff. Third, CCM connects with participants in the Climate MN convenings across greater Minnesota.

Outcomes to date include 1) identification of water protection and management as uniting priority across the regions, 2) shared strategies for engaging a broad network of stakeholders and 3) growing and strengthening the network of community-based and University-based resources.

Poster Session 4:45 p.m. – 5:45 p.m.

12. The Passage Bench: A Review of Their Construction as a Standard Bridge Design on River Crossings in Minnesota

Peter Leete (peter.leete@state.mn.us), MnDNR/MnDOT

The Passage Bench is a gravel pathway incorporated into a bridge's riprap to mimic a typical shoreline game trail. It is incorporated into bridge riprap design to allow wildlife movement in the river corridor. In 2005 the Passage Bench was considered an "experimental design". This design was a collaborative effort of the MnDNR, USFWS Twin Cities Field Office, and MnDOT.

The initial design of the Passage Bench was an effort primarily as a wildlife crossing. Additional benefits for the road authority include ease in bridge inspection, improved design for scour protection, and flexibility in design for normal channel and flood profile. In 2011 the feature became part of the MnDOT Standard Plan Set for use on all bridges in Minnesota.

This poster will show examples of passage benches in a variety of settings and what we have learned as they settle into the landscape. Most installations are intact and are utilized by wildlife successfully. Though there have been failures. This poster will show examples of success, failure, and give explanations of why for both. We are aware that other road authorities are now utilizing this concept and may have similar experiences. The intent of this poster presentation is to promote the sharing of experiences. Sharing lessons learned will lead to further discussion on design or installation methods to increase the success of this design.

13. Rice Creek Commons Comprehensive Stormwater Management Plan

Jonathan Libby, Kimley-Horn; Pamela Massaro, Wenck Associates

How do you ensure that stormwater management requirements are met on a 427-acre, mixed-use redevelopment site that may be phased in over a 15- to 20-year timeframe? Ramsey County prepared the first approved Comprehensive Stormwater Management Plan (CSMP) under Rice Creek Watershed District rules for the Rice Creek Commons redevelopment site in Arden Hills. This CSMP included a combination of regional and parcel specific stormwater features addressing rate control, infiltration, and water quality requirements while also addressing interim and final development conditions. Implementation guidelines had to be general enough to allow final design flexibility for individual parcel development, yet specific enough to ensure regulatory compliance at major development phases. The CSMP was based on a development master plan that includes a natural resource corridor designed for stormwater and wetland features as well as public open space, residential, retail, and flexible business land uses. Phased implementation, shallow groundwater, groundwater contamination, an existing groundwater contamination treatment system, wetland mitigation/preservation, meeting regulatory requirements, and minimizing development constraints were the key challenges to defining the CSMP.

14. Sunlight-driven Transformation of Contaminants of Emerging Concern in Stormwater

Andrew McCabe and William Arnold, University of Minnesota, Department of Civil, Environmental, and Geo-Engineering

Stormwater transports pesticides, pharmaceuticals, antibiotics, and other bioactive contaminants from our cities and farmland to natural or engineered surface waters. Rarely is specific treatment done to remove these contaminants, and consequently we rely on natural processes that transport and transform these contaminants to maintain environmental concentrations below harmful levels. Photochemical reactions initiated by sunlight are important in the natural attenuation of these contaminants and may be important in limiting downstream ecological and human exposure. Little is known, however, about the impact of variable stormwater chemistry (e.g., pH, [DOC], TDS, and organic matter quality) on the photochemical fate of these contaminants. In this study, stormwater samples were collected in collaboration with several watershed districts throughout the Minneapolis-St. Paul metro area during 2015 to study the relationship between watershed land cover, water chemistry, and contaminant photochemistry. The anticipated completion date of this project is spring 2017. Representative photochemical lifetimes of these contaminants and results of regression analyses will be presented. Photochemical fate models for detention ponds will also be discussed.

Poster Session 4:45 p.m. – 5:45 p.m.

15. Seasonal Changes in the Turbidimeter Signal Due to Sediment Color in a Minnesota River Tributary

Gustavo Merten (mertengh@gmail.com), University of Minnesota -Duluth; Paul Capel, UMN-USGS

In situ turbidity meters have been widely used to estimate suspended sediment concentration (SSC) in surface waters where SSC correlates well with turbidity. Theoretically, intra and inter-event sediment size and color variations can affect the manner in which light is scattered and, thus, the relationship between SSC and turbidity. The color of suspended sediment in High Island Creek, a tributary to the Minnesota River, was observed to change from spring to early summer (from pale brown to dark gray) due to variations in sediment source. Based on this observation, a laboratory experiment was carried out to investigate how different sediment colors affect the turbidity signal. Various potential suspended sediment sources (channel beds, banks, and fields) were sieved to <0.0063 mm, then suspended in water to a concentration of 1,000 mg L-1. The color of each of the sediments was evaluated using the Munsel soil-color charts. The results showed no significant statistical differences in the turbidity signal due to differences in color. This suggests that changes in SSC color does strongly not affect the SSC-turbidity relation in High Island Creek.

16. Idea of a Minnesota Water Resources Modeling Group Revisited

Shahram Missaghi (miss0035@umn.edu), Minnesota Extension

Computer models extend the understanding of our environment and are valuable tools for water resources managers. Water resources professionals have steadily increased their reliance on models to equip themselves better in addressing emerging water and environmental challenges. A collaborative group, led by Minnesota Extension, has been offering a series educational programs focused on tools, water resources statistics, and computer models used to protect and restore the integrity of Minnesota's watersheds, streams, and lakes. Our goal is to provide networking, training, resources and research for application and implementation of relevant water resource tools and computer models. The Minnesota Water Resources Modeling Group was created in 2011, to provide an online community to participate in forums, have access to data, and to learn about the latest training opportunities. This interactive poster, with QR Codes for survey and videos, will examine how best we can change, update, and support this unique online community to continue to advance Minnesota water resources.

17. Local Water Supply Planning

Carmelita Nelson, MN Department of Natural Resources; Lanya Ross, Metropolitan Council

All MN public water suppliers that operate a public water distribution system, serve more than 1,000 people and/or all cities with municipal public water supplies in the seven-county metro area, must have a water supply plan approved by the DNR. Water supply plans are updated every ten years and the next updates will be due between 2016 and 2018. While public water suppliers are primarily responsible for completing the plan, collaboration with community planners and surface water managers is important for creating the strongest plan possible.

Benefits of completing a Water Supply Plan:

- Help prepare for droughts and water emergencies.
- Create eligibility for funding requests to the MDH for the Drinking Water Revolving Fund.
- Allow water suppliers to submit requests for new wells or expanded capacity of existing wells.
- Simplify the development of county comprehensive water plans and watershed plans.
- Fulfill a water supplier's statutory obligations under M.S. 103G.291.
- Fulfill the contingency plan provisions required in the MDH wellhead protection and surface water protection plans.
- Fulfill the demand reduction requirements of M.S.103G.291.
- Fulfill metro requirements for local governmental units under M.S. 473.859

Upon implementation, contribute to maintaining aquifer levels, reducing potential well interference and water use conflicts, and reducing the need to drill new wells or expand system capacity.

Poster Session 4:45 p.m. – 5:45 p.m.

18. Alum's Critical Role in Controlling Algae and Phosphorus

Keith Pilgrim (kpilgrim@barr.com) and Greg Wilson, Barr Engineering Company

Sediment phosphorus release is a pervasive problem in nutrient-impaired lakes and reservoirs that exacerbates algal bloom problems, which in turn, limits recreational use and property values. Identifying and appropriately applying cost-effective tools to reduce phosphorus and algae (including harmful algal blooms) in lakes will be a sizeable challenge. Guidance for watershed (external) phosphorus controls is abundant, but there is no guidance on in-lake phosphorus controls.

In-lake alum treatment has been used in Minnesota for more than 27 years to reduce sediment phosphorus release, but it is poorly understood and judgement of alum treatment success is wide-ranging. With global warming, increasing lake temperatures, greater and more frequent algal blooms in lakes, impaired recreation, and diminished property values, there is urgency to develop a better understanding of alum treatment and its role in mitigating these conditions. Barr has compiled several recent studies that have advanced our understanding of the use of alum to reduce internal phosphorus loading. This poster will discuss results of analyses that help explain why some whole-lake alum treatments have succeeded/failed as well as considerations for future planning and assessment. In addition, it will identify where more research is needed to evaluate the limiting factors on the success of past treatments, as well as those factors that can optimize the long-term efficacy of in-lake alum treatments in Minnesota.

19. Advancing Groundwater Implementation through GRAPS

Carrie Raber (carrie.raber@state.mn.us) and Mark Wettlaufer, Minnesota Department of Health

New tools are being developed to help water planners and project managers better incorporate groundwater information. There has been recognition of the need to better incorporate groundwater information into the One Watershed One Plan concept. In response, a statewide project is underway to pilot GRAPS -a set of Groundwater Restoration and Protection Strategies that will complement WRAPS and other local planning efforts. GRAPS is an interagency effort designed to support prioritized and targeted management strategies that protect both ground and drinking water supplies within a designated watershed. Two pilot reports are in development, with an anticipated completion date of fall of 2016.

20. The R/V Blue Heron and the Large Lakes Observatory

Richard Ricketts (ricketts@d.umn.edu), Large Lakes Observatory, UMD

Located on the Duluth campus of the University of Minnesota, the Large Lakes Observatory (LLO) is the only institute in the country dedicated to the study of large lakes throughout the world. We focus on the global implications of our investigations in the areas of aquatic chemistry, circulation dynamics, biogeochemistry, acoustic remote sensing, plankton dynamics, microbial ecology and paleoclimatology.

While we work on lakes in Central and South America, Asia and Africa, one of our major foci are the big lakes in our back yard, the North American Great Lakes. To facilitate that research, the LLO operates the largest University owned research vessel on the Great Lakes, the R/V Blue Heron. This 85' converted fishing trawler has the instrumentation capabilities to support biological, chemical, geological and physical research as well as the endurance to spend 3 weeks on any of the Great Lakes in one stretch. Instrumentation includes a CTD/rosette system for water sampling and measuring water parameters such as temperature, D.O, and chlorophyll content; an underway sampling system for measuring water parameters and collecting samples as the ship moves; mid-water trawling gear; a full suite of sediment sampling gear; geophysical gear including a multibeam sonar, side scan/chirp sub-bottom profiler, and airgun suite, as well as additional equipment.

The vessel is open to all researchers and supports work with investigators from inside the University of Minnesota system, academic researchers from around the country, and researchers from state and tribal groups.

Poster Session 4:45 p.m. – 5:45 p.m.

21. Nearshore Lake Superior Periphyton Surveillance

Elaine Ruzycki (eruzycki@d.umn.edu), Richard Axler and Jerry Henneck, NRRI/UM-Duluth; Jeremy Erickson, St Paul Regional Water Services

In nutrient poor oligotrophic lakes, such as Lake Superior, shallow near shore waters are particularly sensitive to disturbance from development along shoreline and coastal areas. Considerable scientific literature exists regarding the use of periphyton community characteristics to provide a local and fine-scale biomonitor for increased nutrient and sediment runoff impacts. The objectives of this study were to 1) establish baseline conditions for attached algae along the rocky North Shore Lake Superior "splash zone" by developing a sampling protocol and determining areal periphyton biomass and species composition; 2) determine if there is a relationship between periphyton distribution and stormwater outfalls, illicit wastewater discharge, ground water seepage, and various stressor indices of land use along the Minnesota Lake Superior shoreline and 3) to develop a rapid visual bioassessment technique suitable for citizen scientists based on US EPA stream methods and used in oligotrophic Lake Tahoe. In 2013 and 2014 we measured periphyton areal biomass (chlorophyll, dry weight and organic matter) at 17 sites along the MN Lake Superior shoreline from Duluth to Knife River, MN. Sites were selected based on the land use stressors of the adjacent watershed. Periphyton biomass measures showed positive correlation to road density, percent development and population density though interannual differences were apparent. The rapid bioassessment method used at 19 sites along the Cook County shoreline as well as the Duluth sites, includes underwater photographs and a ranking based on observed periphyton growth, appears to be a cost-effective way to detect trends if selected sites have suitable substrate.

22. Illicit Discharge Detection and Elimination Education Program

Leslie Stovring, City of Eden Prairie; Leah Gifford and Walter Eshenaur, SRF Consulting Group, Inc.

The City of Eden Prairie and SRF Consulting Group developed an Illicit Discharge Detection Response (IDDR) Plan to identify and eliminate potential pollution sources to the City's wetlands, lakes, and rivers while meeting the revised MS4 requirements established by the MPCA. The IDDR Plan developed procedures for inspection, reporting, tracking, eliminating, enforcing, and documenting illicit discharges. All participating City departments were consulted in the development of the procedures. High risk areas for illicit discharge were mapped in GIS and a report was created of the most vulnerable outfall locations for inspection within the City.

A major component of the project was a robust education program. All City of Eden Prairie staff members who may work or spend time outdoors were provided education to recognize and report potential Illicit Discharges. The education program includes live training presentations to city staff, a 5-minute training video for future and new employee training, E-blasts and stormwater pamphlets, and two 1 minute educational videos for the public. A user-friendly E-Guide was also created to communicate the plan and its resources to City staff, via the City's intranet site.

Poster Session 4:45 p.m. – 5:45 p.m.

23. Comparison of Alternative Media for the Construction of Stormwater Biofiltration Systems

Josh Swanson, University of Minnesota, Duluth; Meijun Cai, Kurt Johnson, University of Minnesota Duluth, Natural Resources Research Institute; David Saftner and Rebecca Teasley, Department of Civil Engineering, University of Minnesota Duluth

This ongoing research focuses on the evaluation of alternatives to sand and compost for use in stormwater biofiltration systems. The treatment efficiency of a constructed biofiltration system is largely dependent upon the properties of the filter media. Current Minnesota Department of Transportation specifications utilize a mixture of organic compost and clean sand to support vegetative growth, infiltrate stormwater, and improve water quality. The use of salvage material locally available for biofiltration media has economic benefits, but the biological, hydraulic, and water quality improvement capabilities are largely unknown. A multidisciplinary effort to determine these abilities includes investigations of soil fertility, infiltration capacity, water retention capacity and pollutant removal efficiencies of peat, muck, compost and taconite tailings collected from northern Minnesota. Soil fertility is evaluated through the use of compost maturity tests, seed germination experiments, and greenhouse growth trials. The investigation of infiltration and water retention capacity is conducted in multiple phases. Initially, field saturated hydraulic conductivity and infiltration rate data are obtained from laboratory column experiments. This data is utilized to design media mixtures which are further tested in laboratory-scale rainfall simulation plots to more accurately predict regulatory compliance. Pollutant removal efficiency will be determined by laboratory batch experiments and rain bed leaching experiments. These experiments will focus on the effects to pH, the removal of nutrients (nitrogen and phosphorus) and heavy metals (copper, lead and zinc). Preliminary findings from this research are available with final results expected by October 31st, 2016.

24. Phosphorus in the Shell Rock Watershed

Bill Thompson (bill.thompson@state.mn.us), Minnesota Pollution Control Agency

The Shell Rock River begins in Minnesota's Freeborn County, and flows into Iowa as a tributary to the Cedar River. In addition to a 12-mile reach of the Shell Rock river in Minnesota, there are significant lake and agricultural resources in the watershed, and the regional city of Albert Lea. Phosphorus is the key nutrient driving lake eutrophication as well as low dissolved oxygen in the low-gradient Shell Rock River. The purpose of this poster will be to organize and summarize numerous efforts to monitor, model, reduce, and improve management of phosphorus, across the landscape of sources, scales, and entities. This will be a compilation and assessment of work that includes monitoring by local units of government, TMDL work by local units of government and state agencies, and special projects by the University of Minnesota. These multiple efforts will be characterized as those leading to a better understanding of this nutrient for improved efficiency and management, and for better surface water quality in the future.

25. A Direct-Push Sample-Freezing Drive Shoe for Collecting Sediment Cores with Intact Pore Fluid, Microbial, and Sediment Distributions

Jared Trost (jtrost@usgs.gov) and Barbara Bekins, U.S. Geological Survey; Tom Christy, Geoprobe Systems

Abiotic and biological reactions in shallow groundwater and bottom sediments are central to understanding groundwater contaminant attenuation and biogeochemical cycles. The laminar flow regime in unconsolidated surficial aquifers creates narrow reaction zones. Studying these reaction zones requires fine-scale sampling of water together with adjacent sediment in a manner that preserves in situ redox conditions. Collecting representative samples of these narrow zones with traditional subsurface sampling equipment is challenging. For example, use of a basket type core catcher for saturated, non-cohesive sediments results in loss of fluid and sediments during retrieval.

A sample-freezing drive shoe designed for a wire line piston core sampler allowed collection of cores with intact sediment, microbial, and pore fluid distributions and has been the basis for studies documenting centimeter-scale variations in aquifer microbial populations. However, this freezing drive shoe design is not compatible with modern-day direct push sampling rigs.

A re-designed sample-freezing drive shoe compatible with a direct-push dual-tube coring system was developed and field-tested. The freezing drive shoe retained sediments and fluid distributions in saturated sediment core samples by freezing a 10 centimeter plug below the core sample with liquid CO2. Core samples collected across the smear zone at a crude oil spill site near Bemidji, Minnesota, were successfully extracted without loss of fluid or sediment. Multiple core sections in the aquifer were retrieved from a single hole. This new design makes an effective sampling technology available on modern-day direct push sampling equipment to inform myriad questions about subsurface biogeochemistry processes.

Poster Session 4:45 p.m. – 5:45 p.m.

26. Iron Oxide Mineral Nanoparticles: Fate and Transport of Nitrobenzene Pesticides

Jeanette Voelz (tensf001@umn.edu), William Arnold and R. Lee, Penn, University of Minnesota - Twin Cities

Pesticides with nitro- functional groups are commonly used nationwide. These compounds are mobile in the environment, especially after reductive transformation into aniline species, which are more toxic and more water-soluble. This transformation rate is dramatically increased in the presence of aq. Fe(II) and iron oxides like goethite (Î±-FeOOH) and hematite (Î±-Fe2O3), which are common soil minerals in Minnesota. Nanoparticles of these reactive minerals are particularly important because of the high surface area-to-volume ratio. At the water-mineral interface, we seek to determine how iron oxide reactivity changes as a function of solution conditions and how recurrent exposures of contaminants cause reactivity to evolve. Experiments are performed in anaerobic conditions using batch reactors containing synthetic iron oxides, bicarbonate pH buffer, aq. Fe(II), and standardized organic matter. Reaction rates are monitored using High-Performance Liquid Chromatography, in-situ aggregation state is quantified using Dynamic Light Scattering and Zeta-Potential, and changes to mineral surfaces are characterized by X-Ray Diffraction and Transmission Electron Microscopy. Further, using mathematical modeling we can predict the fate and transport of pesticides based on known regional hydrology and geology. By evaluating the risks inherent in pesticide use by geographical region, we can work to prevent the contamination of water resources. Completion: Summer 2019.

27. Reliable Reduction of Agricultural Runoff: Tradeoffs Involving Variation of Water Quality

Zhiyu Wang, Jay Coggins, University of Minnesota

How can the agricultural community effectively maintain water quality and agricultural productivity? The answer involves a tradeoff between reduction on nutrient runoff and agricultural return. Most commonly, a target of water quality in agriculture is set at reduction on nutrient runoff, with no consideration on how frequently the target will be met. When environmental damages are influenced by peak flows of agricultural runoff, seasonally or annually, this type of target is far from the whole picture of water quality improvement. It is necessary to pay attention to the variation of agricultural runoff. A probabilistic constraint, in this sense, becomes indispensable to guarantee the reliability of water quality improvement, or reliable reduction on nutrient runoff. This paper provides a way to consider this reliable reduction problem and agricultural return. It also proposes an alternative way to reformulate the problem, which translates different levels of reliability requirements into additional reduction on runoff.

28. Linking Hydrologic Flux and Root Zone Geochemistry at Second Creek, a Sulfate Enriched Wild Rice Stream in Northeastern Minnesota

Amanda Yourd (aryourd@umn.edu), Gene-Hua Crystal Ng and Amy Myrbo, University of Minnesota Twin Cities - Department of Earth Sciences; Nathan Johnson, University of Minnesota Duluth - Department of Earth Sciences

Wild rice (Zizania palustris) is an economically, culturally, and ecologically important aquatic plant species in Minnesota. In northeastern Minnesota, iron mining has led to elevated surface water sulfate concentrations, which has raised concern about the potential of sulfate to negatively impact wild rice populations. A recent Minnesota Pollution Control Agency (MPCA) study showed that excess sulfide in the wild rice root zone (sediment porewater) is more closely correlated with wild rice degradation than surface water sulfate. This toxic porewater sulfide can be attenuated by locally available dissolved iron via the precipitation of iron sulfide minerals. Although these geochemical reactions occur in the sediment porewater, or hyporheic zone, where groundwater and surface water mix, the MPCA study did not examine the effect of groundwater geochemistry or hydrologic flux on wild rice root zone geochemistry. Here, we use physical hydrologic and gecheochemical field data collected during the summer of 2015 from Second Creek, a mining impacted wild rice stream in northeastern Minnesota, to inform a reactive transport model. The model examines the geochemical response of the sediment porewater to changes in hydrologic flux condition, surface water chemistry, and groundwater chemistry. We show that porewater sulfide accumulation is dependent on hydrologic flux direction and magnitude, with greater sulfide accumulation during periods of downward flux, when sulfate-rich surface water moves down into sediment porewater. By project completion in December 2016, it is our hope that this work will emphasize the importance of constraining hydrologic flux when examining geochemical processes at the groundwater-surface water interface.